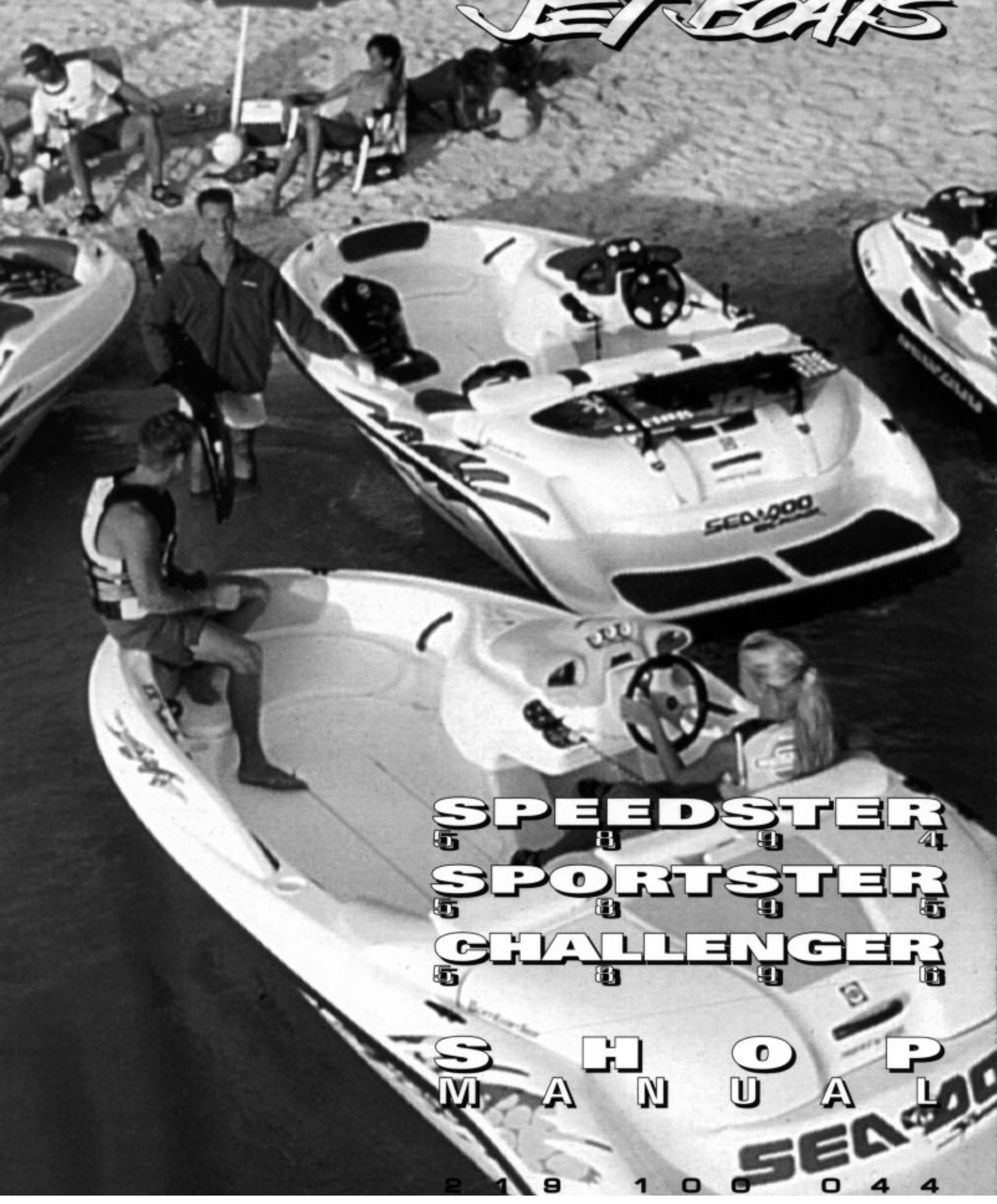






SEA·DOO® JET BOATS



SPEEDSTER

5 8 9 4

SPORTSTER

5 8 9 5

CHALLENGER

5 8 9 6

**S H O P
M A N U A L**

2 1 8 1 0 0 0 4 4



SEA400®
JET BOATS

1996
Shop Manual



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4th trimester 1995

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Snap-on® is a trademark of Snap-on Tools Corporation.

Gelcote® is a trademark of Gelcote International Limited.

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SAFETY NOTICE

This manual was primarily published to be used by jet boat technicians trained by the manufacturer who are already familiar with all service and maintenance procedures relating to Bombardier made Sea-Doo jet boat.

Please note that the instructions will apply only if proper hand tools and special service tools are used.

It is understood that this manual may be translated into local language upon certain conditions and furthermore agreed that in the event of any discrepancy among the two versions, the English version shall prevail.

The content depicts parts and / or procedures applicable to the particular product at its time of manufacture. It does not include dealer modifications, whether authorized or not by Bombardier, after manufacturing the product.

The use of Bombardier parts is most strongly recommended when considering replacement of any component. Dealer and / or distributor assistance should be sought in case of doubt.

Torque wrench tightening specifications must be strictly adhered to. Locking devices (ex. : locking disk, lock nut) must be installed or replaced with new ones, where specified. If the efficiency of a locking device is impaired, it must be renewed.

This manual emphasizes particular information denoted by the wording and symbols ;

◆ **WARNING** : Identifies an instruction which, if not followed, could cause serious personal injury including possibility of death.

▼ **CAUTION** : Denotes an instruction which, if not followed, could severely damage watercraft components.

○ **NOTE** : Indicates supplementary information needed to fully complete an instruction.

Although the mere reading of such information does not eliminate the hazard, your understanding of the information will promote its correct use. Always use common shop safety practice.

This information relates to the preparation and use of Bombardier jet boat and has been utilized safely and effectively by Bombardier Inc. However, Bombardier Inc. disclaims liability for all damages and / or injuries resulting from the improper use of the contents. We strongly recommend that any services be carried out and / or verified by a highly skilled professional technician. It is understood that certain modifications may render use of the boat illegal under existing federal, provincial and state regulations.

1996 BOMBARDIER JET BOAT SHOP MANUAL

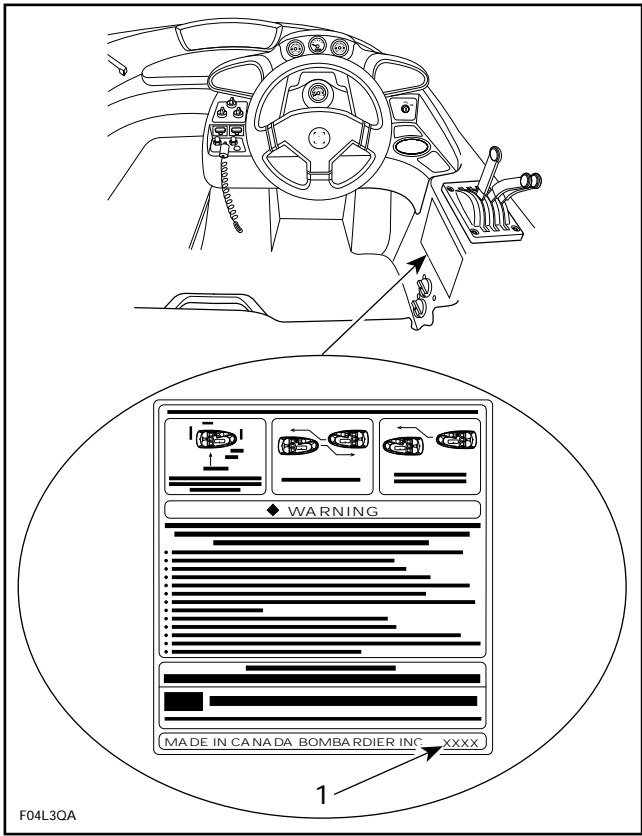
INTRODUCTION

This Shop Manual covers the following BOMBARDIER made SEA-DOOr jet boats.

MODEL	MODEL NUMBER
SPORTSTER	5895
SPEEDSTER	5894
CHALLENGER	5896

BOAT MODEL NUMBER

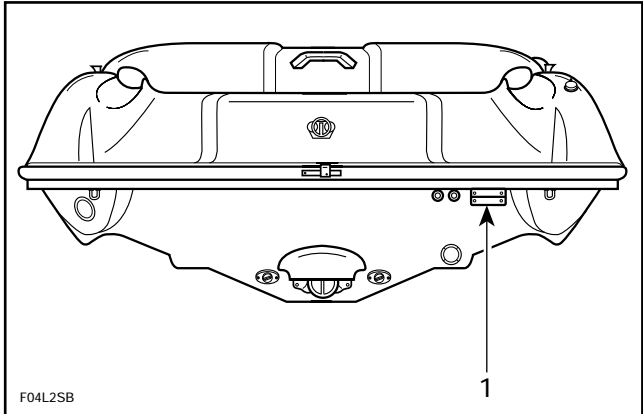
The jet boat model number can be found on RH side of operator position.



1. Model number

HULL IDENTIFICATION NUMBER (H.I.N.)

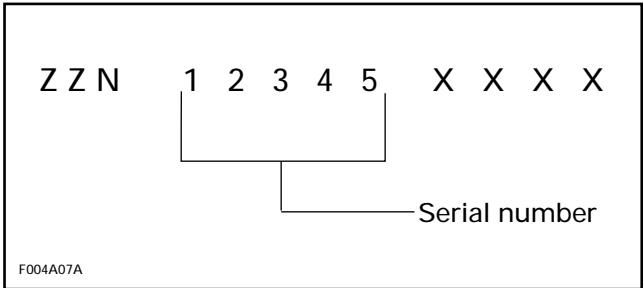
The Hull Identification Number (H.I.N.) is located at right hand rear side of hull.



TYPICAL

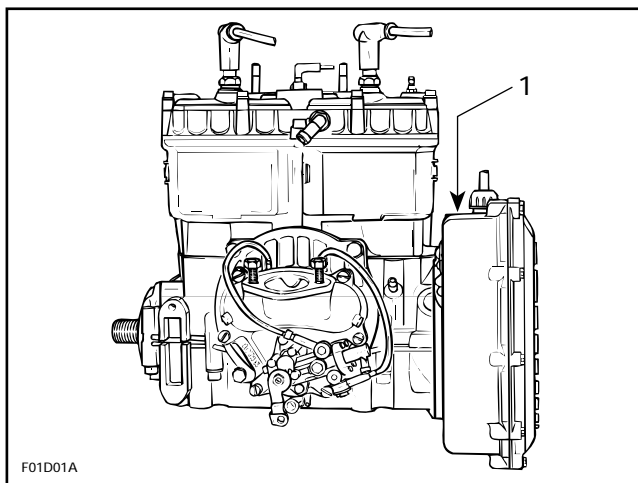
1. Hull Identification (H.I.N.)

The 5 digits after ZZN are the boat serial number.



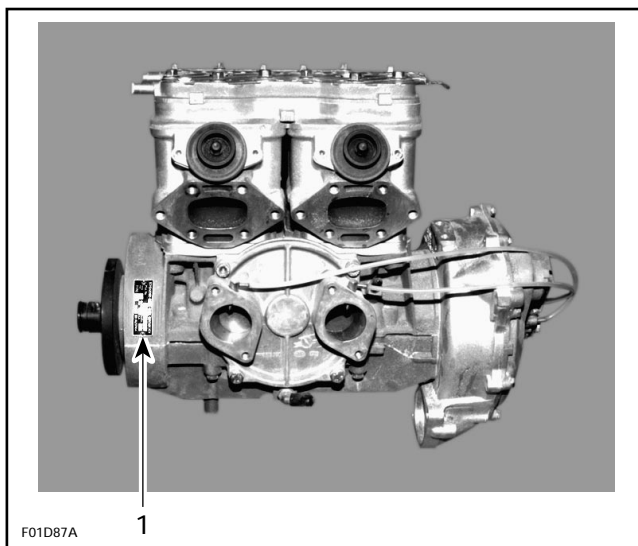
ENGINE IDENTIFICATION NUMBER (E.I.N.)

It is located on the upper side of the magneto housing.



TYPICAL-717 ENGINE

1. Engine Identification Number (E.I.N.)



787 ENGINE

1. Engine Identification Number (E.I.N.)

ARRANGEMENT OF THIS MANUAL

The manual is divided into 12 major sections :

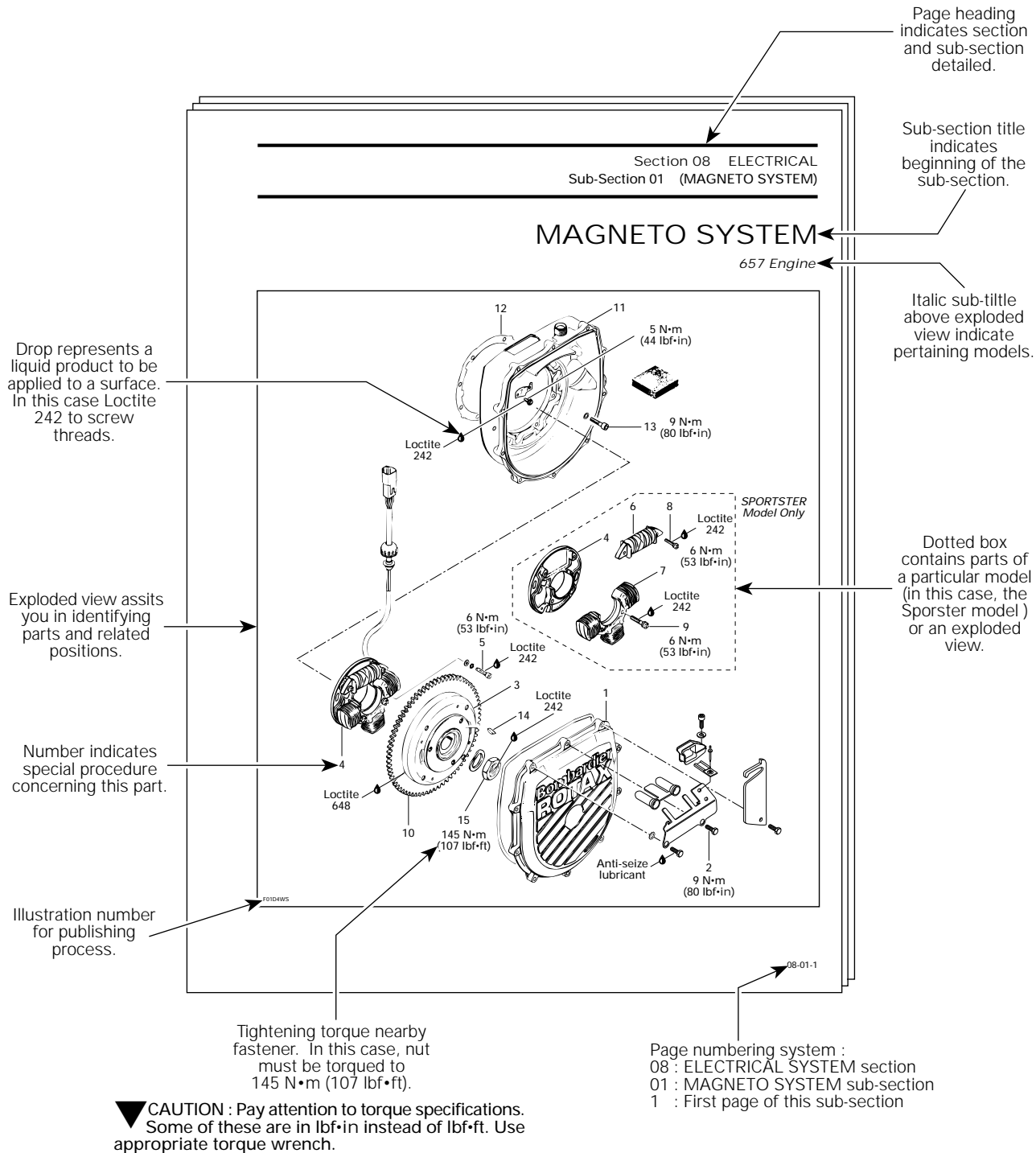
- 01 SERVICE TOOLS AND PRODUCTS
- 02 MAINTENANCE
- 03 TROUBLESHOOTING
- 04 ENGINE
- 05 COOLING SYSTEM
- 06 FUEL SYSTEM
- 07 LUBRICATION SYSTEM
- 08 ELECTRICAL
- 09 PROPULSION AND DRIVE SYSTEMS
- 10 STEERING SYSTEM
- 11 HULL / DECK
- 12 TECHNICAL DATA

Each section is divided in various sub-sections, and again, each sub-section has one or more division. A table of contents is included at the beginning of most sections.

1996 BOMBARDIER JET BOAT SHOP MANUAL

This *Shop Manual* uses technical terms which may be slightly different from the ones in the *Parts Catalog*.

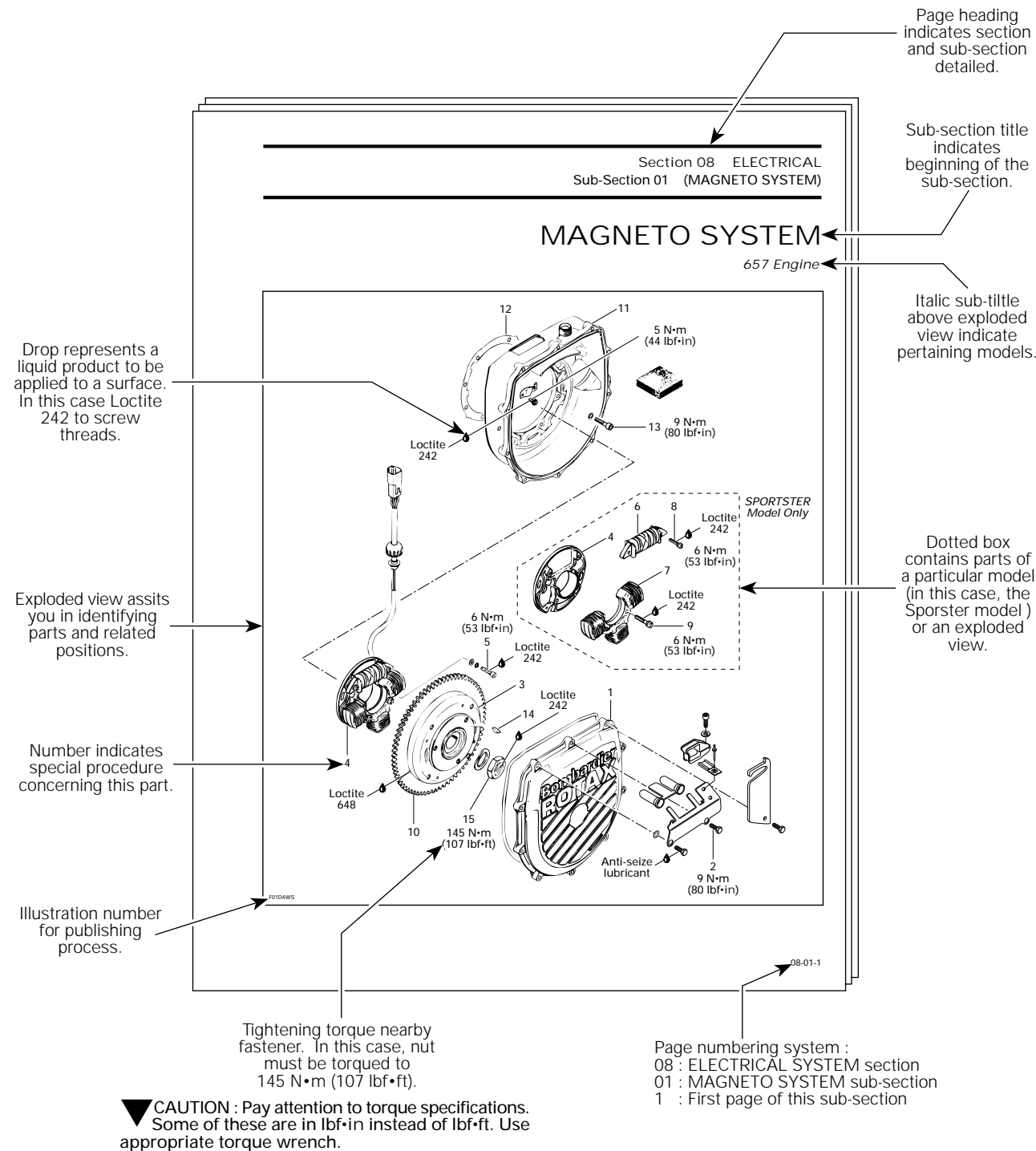
TYPICAL PAGE



1996 BOMBARDIER JET BOAT SHOP MANUAL

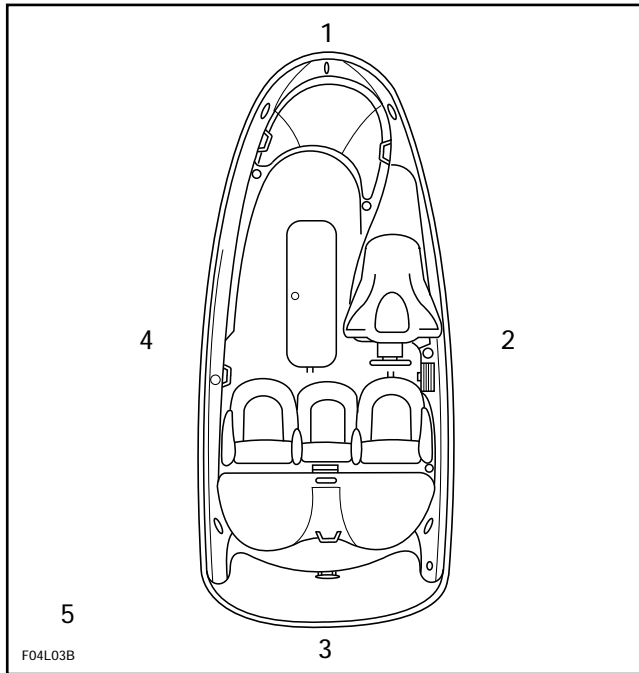
This *Shop Manual* uses technical terms which may be slightly different from the ones in the *Parts Catalog*.

TYPICAL PAGE



1996 BOMBARDIER JET BOAT SHOP MANUAL

GENERAL INFORMATION



1. BOW (front)
2. STARBOARD (RH)
3. STERN (rear)
4. PORT (LH)

5. In marine industry, PORT, STARBOARD, BOW and STERN are used to refer to LEFT, RIGHT, FRONT and REAR respectively. They always refer to the operator's position sitting in boat.

The information and component / system descriptions contained in this manual are correct at time of publication. Bombardier Inc. however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on products previously manufactured.

Bombardier Inc. reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

This Shop Manual uses technical terms which may be different from the ones of the Parts Catalogs.

When ordering parts always refer to the specific model Parts Catalogs.

ILLUSTRATIONS AND PROCEDURES

The illustrations show the typical construction of the different assemblies and, in all cases, may not reproduce the full detail or exact shape of the parts shown, however, they represent parts which have the same or a similar function.

▼ **CAUTION :** These boats are designed with parts dimensioned in both the metric and the imperial systems. When replacing fasteners, make sure to use only those recommended by Bombardier. Mismatched or incorrect fasteners could cause damage to the boat or possible personal injury.

As many of the procedures in this manual are interrelated, we suggest, that before undertaking any task, you read and thoroughly understand the entire section or sub-section in which the procedure is contained.

A number of procedures throughout the book require the use of special tools. Before commencing any procedure, be sure that you have on hand all the tools required, or approved equivalents.

Technical Publications
Bombardier Inc.
Valcourt (Quebec), Canada

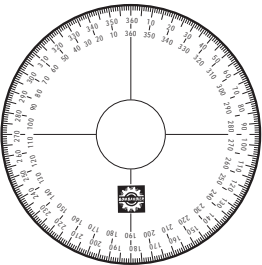
MANDATORY TOOLS

NOTE : The numbers outlined in black (example : **1**) are reference numbers to tools from other divisions (Sea-Doo and / or Sea-Doo Jet Boats). Matching numbers are the same tool even if the part numbers are different.

ENGINE

Degree wheel
P / N 295 000 007

1

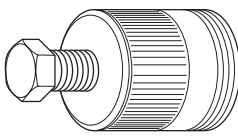


A00B334

APPLICATION
All models.

Puller
P / N 295 000 106

5

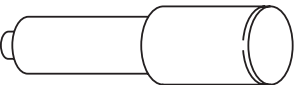


A00C1A4

APPLICATION
All models.

Pusher
P / N 290 876 500

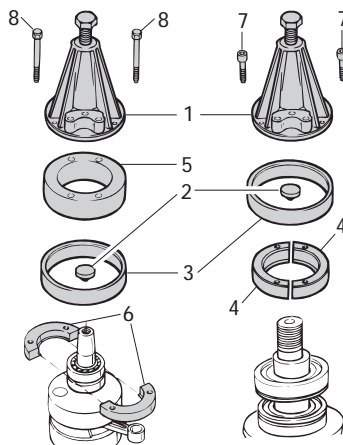
12



A00B2J4

APPLICATION
All models.

F01D884



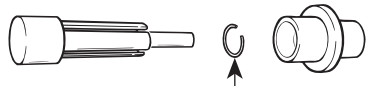
MAG side PTO side

1) Puller	200
P / N 290 876 298	
2) Protective cap (both ends)	554
P / N 290 876 557	
3) Ring (both ends)	555
P / N 290 977 490	
4) Ring halves (PTO)	556
P / N 290 977 475 (2)	
5) Distance ring (MAG)	557
P / N 290 876 569	
6) Ring halves (MAG)	558
P / N 290 276 025 (2)	
7) Screw M8 x 40	559
P / N 290 840 681 (2)	
8) Screw M8 x 70	560
P / N 290 841 201 (2)	

APPLICATION
All models.

Piston circlip installer
A) P / N 295 000 077
B) P / N 290 877 016

202
548



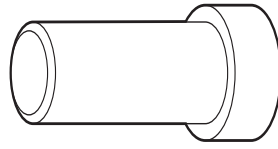
Piston circlip

A01B1P4

APPLICATION
A) 587 engine.
B) 657 and 717 engines.

Pusher
P / N 290 876 605

229

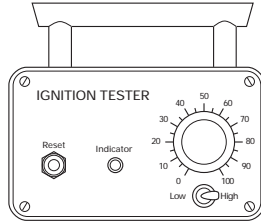


A00C0Y4

APPLICATION
All models.

Bombardier ignition tester
P / N 295 000 008

236



IGNITION TESTER

Reset Indicator

0 10 20 30 40 50 60 70 80 90 100

Low High

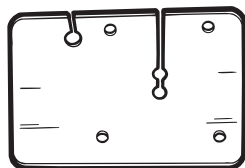
A00C1K4

APPLICATION
All models.

Section 01 SERVICE TOOLS AND PRODUCTS

Sub-Section 01 (MANDATORY TOOLS)

Rubber pad **547**
P / N 295 000 101



F01B0J4

Puller plate **549**
P / N 290 876 080



A00C1R4

Extension handle **550**
P / N 295 000 125



F01D164

Screw M8 x 35 (3) **551**
P / N 290 841 591



F00A094

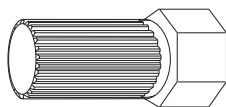
Sleeve (3) **552**
P / N 290 847 220



F00A0A4

APPLICATION
All models.

PTO flywheel remover / installer **553**
P / N 295 000 001



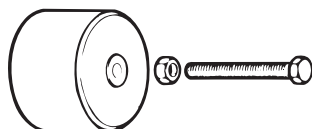
F01J0T4

APPLICATION

All models.

NOTE : This tool is also used for the impeller.

Puller **562**
P / N 290 876 488

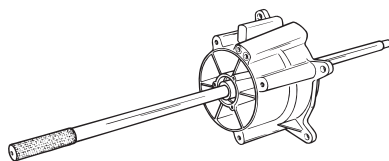


F01B0I4

APPLICATION

All models.

A) Alignment tool support **563**
P / N 295 000 090
B) Alignment shaft **571**
P / N 295 000 093

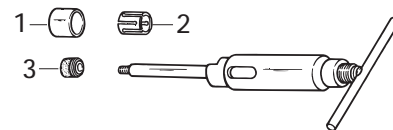


F01L2R4

APPLICATION

All models.

Piston pin puller **566**
P / N 295 000 092



Replacement parts :

1. Locating sleeve **772**
P / N 290 877 181
2. Expansion sleeve **771**
P / N 290 877 041
3. Extracting nut **770**
P / N 290 877 155

F01B0V4

APPLICATION

All engines.

MPEM programmer **567**
P / N 295 000 127



F01B254

APPLICATION

787 engine.

Section 01 SERVICE TOOLS AND PRODUCTS
Sub-Section 01 (MANDATORY TOOLS)

Ring gear blocking tool
P / N 295 000 134

568



F01B264

APPLICATION
787 engine.

Ring gear puller tool
P / N 420 976 235

569



F01B294

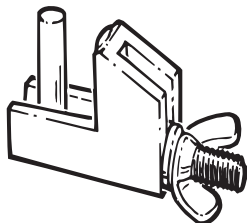
APPLICATION
787 engine.

Section 01 SERVICE TOOLS AND PRODUCTS
Sub-Section 01 (MANDATORY TOOLS)

COOLING / FUEL / OIL SYSTEMS

Hose pincher
P / N 295 000 076

2

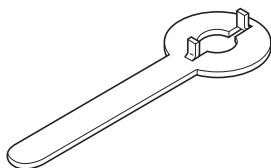


A01B214

APPLICATION
All models.

Gear holder
P / N 290 277 905

235

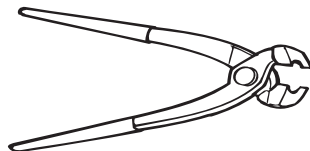


A00C164

APPLICATION
717 engine.

Pliers
P / N 295 000 070

601

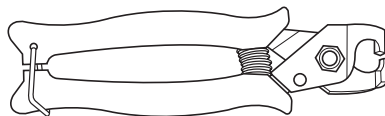


F01D174

APPLICATION
All models.

Pliers
P / N 295 000 054

606



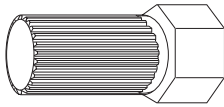
F01B1T4

APPLICATION
All models.

NOTE : This tool is also used
for the propulsion system.

PROPULSION SYSTEM

Impeller remover /
installer **553**
P / N 295 000 001



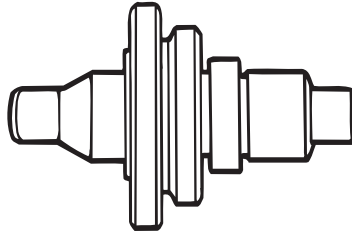
F01J0T4

APPLICATION

All models.

NOTE : This tool is also
used for the PTO flywheel.

Bearing / seal installer **604**
P / N 295 000 107

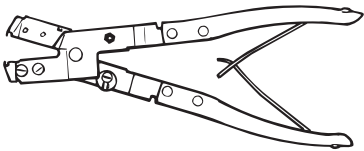


F01J4K4

APPLICATION

All models.

Pliers **602**
P / N 295 000 069

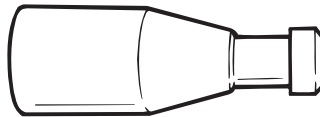


F01D184

APPLICATION

All models.

Impeller shaft guide **605**
P / N 295 000 002

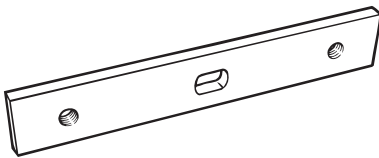


F01J104

APPLICATION

All models.

Impeller shaft holder **603**
P / N 295 000 082

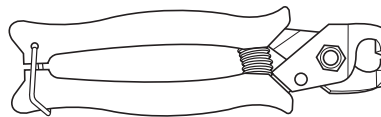


F01B0W4

APPLICATION

All models.

Pliers **606**
P / N 295 000 054



F01B1T4

APPLICATION

All models.

NOTE : This tool is also used
for the fuel system.

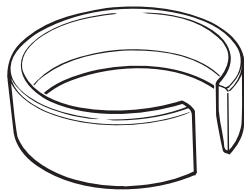
RECOMMENDED TOOLS

NOTE : The numbers outlined in black (example : **1**) are reference numbers to tools from other divisions (Sea-Doo and / or Sea-Doo Jet Boats). Matching numbers are the same tool even if the part numbers are different.

ENGINE

Ring compressor
P / N 290 876 979

766



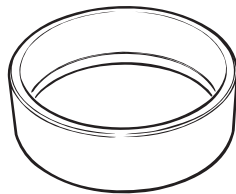
A01B1T4

APPLICATION

All engines.

Coil centering tool
P / N 290 876 922

209



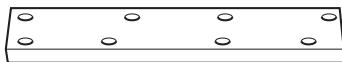
A01B1V4

APPLICATION

717 engine.

Cylinder aligning tool
P / N 290 876 904

220



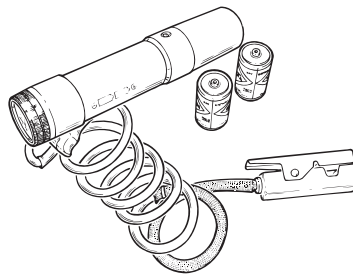
A00B084

APPLICATION

All models.

Stroboscopic timing light
P / N 295 000 078

225



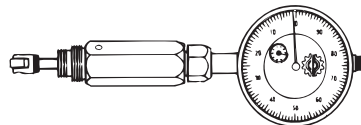
A01B2K4

APPLICATION

All models.

Dial indicator
(TDC gauge)
P / N 295 000 143

230



A00B2E4

APPLICATION

All models.

Distance gauge
A) P / N 290 876 827
B) P / N 290 876 828

561

760



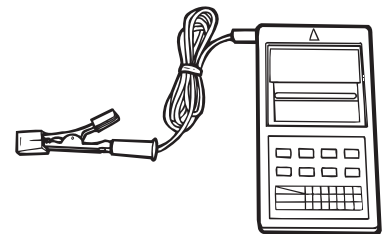
F01B0H4

APPLICATION

A) 717 engine.
B) 787 engine.

Digital / induction type
tachometer
P / N 295 000 100

237



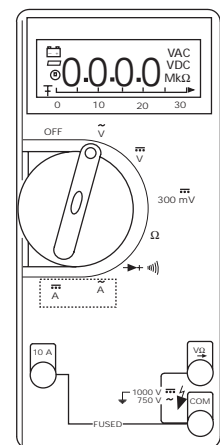
F01B1G4

APPLICATION

All models.

Digital multimeter
P / N 529 022 000

242



F01B1O4

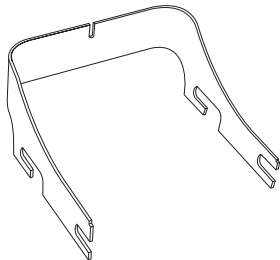
APPLICATION

All models.

Section 01 SERVICE TOOLS AND PRODUCTS

Sub-Section 02 (RECOMMENDED TOOLS)

Timing mark pointer **774**
P / N 295 000 130



F01B204

APPLICATION
717 engine.

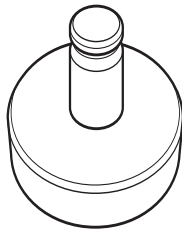
Timing mark pointer **754**
P / N 295 000 135



F01H544

APPLICATION
787 engine.

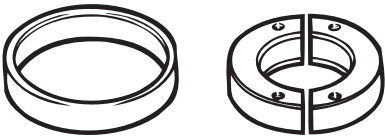
Oil seal pusher **759**
P / N 290 877 740



F01B2C4

APPLICATION
787 engine.

Ring halves and ring
P / N 290 876 330 (halves) **761**
P / N 290 876 480 (ring) **762**



F01B2D4

APPLICATION
787 engine.

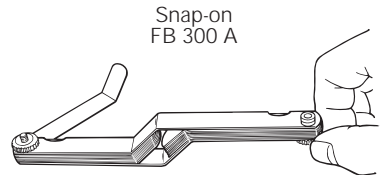
Engine lifting device
Not sold by Bombardier
Do it yourself
Refer to *Shop Manual* section
04-01



F01D0A4

APPLICATION
All models.

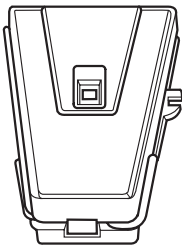
Feeler gauge 45°
Not sold by Bombardier



F01B1K4

APPLICATION
All models.

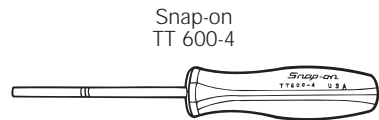
Spark tester
Not sold by Bombardier
Superex Canada Ltd
No. 15-785



F01B1H4

APPLICATION
All models.

Terminal remover
Not sold by Bombardier

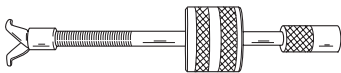


F01B1J4

APPLICATION
All models.

Slide hammer puller
Not sold by Bombardier

Snap-on : Handle CJ93-1
Hammer CJ125-6
Claws CJ93-4



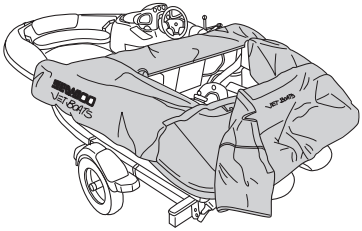
NOTE : This tool is also
used to pull out impeller
shaft seal.

F01J0Z4

APPLICATION
All models.

Section 01 SERVICE TOOLS AND PRODUCTS
Sub-Section 02 (RECOMMENDED TOOLS)

Protective mat **890**
P / N 295 000 129



F04L1V4

APPLICATION

All models.

Rotary valve shaft
pusher **757**
P / N 290 876 609

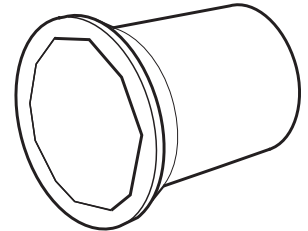


F01B2B4

APPLICATION

787 engine.

Exhaust outlet tool **831**
P / N 295 000 132

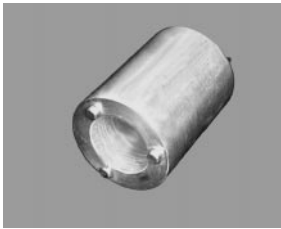


F01B2A4

APPLICATION

Sportster and Speedster.

Safety lanyard switch tool **775**
P / N 295 000 121

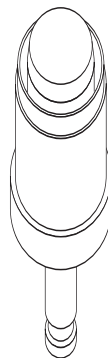


F01B244

APPLICATION

All models.

Handle **758**
P / N 290 877 650

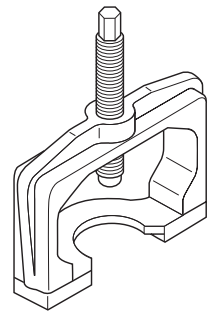


A00C3V4

APPLICATION

787 engine.

Gear / bearing puller **765**
P / N 290 877 665



F04B034

APPLICATION

787 engine.

A) Four-pin magneto
harness **763**
P / N 295 000 131

B) Six-pin magneto
harness **755**
P / N 295 000 136



F01B284

APPLICATION

A) 717 engine.

B) 787 engine.

Section 01 SERVICE TOOLS AND PRODUCTS

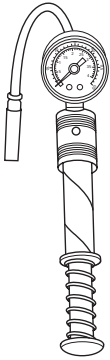
Sub-Section 02 (RECOMMENDED TOOLS)

COOLING / FUEL / OIL SYSTEMS

Pump gauge tester
(carburetor)

826

P / N 295 000 114



F01B0X4

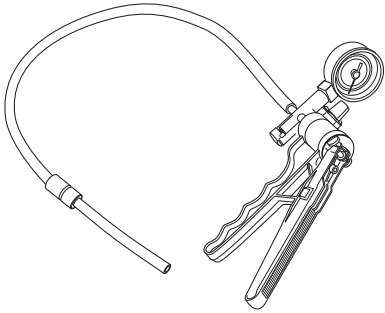
APPLICATION

All models.

Pump gauge tester
(fuel / oil reservoirs)

827

P / N 295 000 085



F01B0Y4

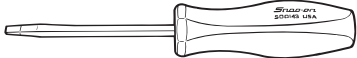
APPLICATION

All models.

Screwdriver

Not sold by Bombardier

Snap-on
SDD-143



F01B1P4


APPLICATION

All models.

Lighted adjustable mirror

Not sold by Bombardier

Snap-on
50101



F01B114

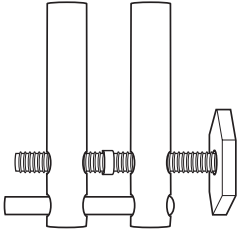
APPLICATION

All models.

Hose pincher

773

P / N 529 030 400



F01B234

APPLICATION

All engines.

PROPULSION SYSTEM

Fitting
P / N 295 000 086

828

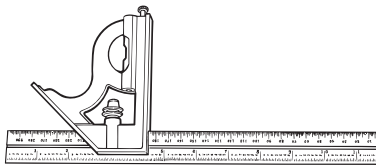


F01B0Z4

APPLICATION
All models.

Machinist's square
Not sold by Bombardier

Snap-on
PMF 122



F02B064

APPLICATION
Models equipped with reverse.

Bearing remover
Not sold by Bombardier
Do it yourself
Refer to *Shop Manual* section 09-01

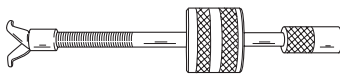


F01J114

APPLICATION
All models.

Slide hammer puller
Not sold by Bombardier

Snap-on : Handle CJ93-1
Hammer CJ125-6
Claws CJ93-4



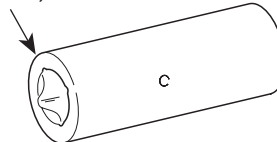
NOTE : This tool is also used to remove rotary valve shaft bearing.

F01J0Z4

APPLICATION
All models.

Fitting remover
Not sold by Bombardier
Do it yourself
Refer to *Shop Manual* section 09-01

Deep socket
14 mm
(9/16 in)



F01J2RA

APPLICATION
All models.

Flexible spout (oil)
P / N 414 8373 00

834

APPLICATION
All models.

Hacksaw
Not sold by Bombardier

Snap-on
HS3



F01B1M4

APPLICATION
All models.

SERVICE PRODUCTS

NOTE : The numbers outlined in black (example : **1**) are reference numbers to tools from other divisions (Sea-Doo and / or Sea-Doo Jet Boats). Matching numbers are the same tool even if the part numbers are different.

Medium strength
threadlocker
P / N 293 800 015

154

Loctite 242 (blue)
(10 mL)



A00B324

APPLICATION

Cylinder head screws
(All engines).
Tuned pipe nut and screws.
Engine rubber mount screws.
Armature plate screws.
Magneto flywheel / crankshaft.
Carburetor mount nuts / screws.
Magneto coil screws.
Impeller housing cover screws
(except for plastic pumps).
Venturi / impeller housing
screws.
Intake grate screws.
Engine support screws.
Impeller housing / hull nuts.
Steering nozzle screws.
Reverse gate screws.

High strength
threadlocker
P / N 293 800 005

155

Loctite 271 (red)
(10 mL)



A00B2U4

APPLICATION

Impeller shaft thread.

High temperature
threadlocker
P / N 290 899 788

359

Loctite 648 (green)
(5 g)



A00B3D4

APPLICATION

Crankcase / plug at end of rotary
valve shaft.
Magneto / ring gear.

Paste gasket
P / N 293 800 007

152



Loctite 515
(50 mL)

A00B2T4

APPLICATION

Cylinder sleeve / O-ring groove.
Crankcase halves mating surface.
Crankcase screws.

Paste gasket
P / N 293 800 038

376



Loctite 518
(50 mL)

F01B124

APPLICATION

Impeller housing cover.
Venturi / impeller housing.
Impeller shaft seal.

Section 01 SERVICE TOOLS AND PRODUCTS

Sub-Section 03 (SERVICE PRODUCTS)

Solvent 157

P / N 293 800 019

Loctite Safety
Solvent 755



A00B3M4

APPLICATION

Impeller shaft threads.
Drive shaft splines.
Impeller threads and splines.

Primer for paste gasket 158

P / N 293 600 013

Loctite
Locquic Primer N
170 g (6 oz)



A00B3N4

APPLICATION

Crankcase halves mating surface.
Impeller shaft thread.
Venturi / impeller housing mating surface.

Gasket stripper 935

N / P 295 500 110



F01B1W4

APPLICATION

Mating surfaces of cylinders and crankcase.
Crankcase halves.

Pipe sealant 358

P / N 293 800 018

Loctite 592
(50 mL)



A00B2W4

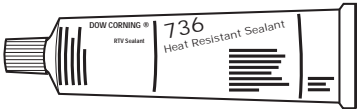
APPLICATION

Plug on impeller housing cover.
Plastic fitting tool (P / N 295 000 086) on impeller housing cover.
Cooling system fittings.

Heat resistant sealant 374

P / N 413 709 200

Dow Corning 736



A00B3U4

APPLICATION

Tuned pipe.

Dielectric grease 350

P / N 293 550 004

Dow Corning



F01B164

APPLICATION

Battery posts and cable connectors.
Thermosensor switch.

Grease 924

P / N 293 550 005

(400 g)



A00B2L4

APPLICATION

PTO flywheel.

Section 01 SERVICE TOOLS AND PRODUCTS
Sub-Section 03 (SERVICE PRODUCTS)

Synthetic grease **912**
P / N 293 550 010



Sea-Doo
(400 g)

F01B154

APPLICATION

Cylinder and cylinder head screws.
Carburetor linkage.
Impeller shaft seal lips.
Drive shaft / impeller splines.
PTO flywheel

Lubricant
Not sold by Bombardier

G.E. Versilube
G341M



or
Esso Beacon 325

A00B1T4

APPLICATION

Sliding surface of starter armature shaft splines.

Anti-seize lubricant **362**
P / N 293 800 023

Loctite anti-seize
lubricant
12 oz (454 g)



F01B174

APPLICATION

Crankshaft thread / PTO flywheel.
Crankshaft bearing seat.
Spark plug threads.
Ignition housing cover screws.

Penetrating lubricant **913**
P / N 293 600 016

Bombardier
Lube



F01B0S4

APPLICATION

Throttle cable.
Wear ring (when new).
Corroded parts.
Water flooded engine.
Storage.

Sea-Doo fuel stabilizer **375**
P / N 413 408 600



A00B3V4

APPLICATION

Fuel system.

Bombardier-Rotax injection oil **915**
P / N 413 802 900 12 x 1 L



F01B184

APPLICATION

All models.

Section 01 SERVICE TOOLS AND PRODUCTS

Sub-Section 03 (SERVICE PRODUCTS)

Bombardier-Rotax
injection oil

P / N 413 803 000 3 x 4 L 916

P / N 413 803 200 205 L 962



F01B2H4

APPLICATION

All models.

Jet pump oil

P / N 293 600 011 914

Sea-Doo jet pump
synthetic oil



F01B0P4

APPLICATION

All models.

A) Silicone «Ultra Black» 901

P / N 293 800 030

B) Silicone «Ultra Black HB» 902

P / N 293 800 028



F01B1A4

APPLICATION

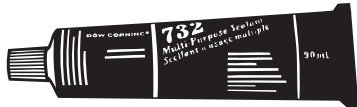
Ride shoe.

Jet pump fittings.

732 Multi-purpose sealant 917

P / N 293 800 006

Dow Corning
(Clear)



F01B1C4

APPLICATION

Ride shoe screws.

Sealant adhesive 934

P / N 293 800 033

(Clear)



F01B1S4

APPLICATION

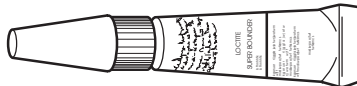
Ride shoe screws.

Sponson.

General purpose instant
adhesive 373

P / N 293 800 021

Loctite 495



A00B2V4

APPLICATION

Rubber to metal bonding and
most hard plastic.

Adhesive activator 931

P / N 293 530 036



F01B1Z4

APPLICATION

Decals.

Sea-Doo Cleaner

P / N 293 110 001 400 g 946

P / N 293 110 002 4 L 947



F01B2J4

APPLICATION

All models.

Section 01 SERVICE TOOLS AND PRODUCTS
Sub-Section 03 (SERVICE PRODUCTS)

Gelcoat spray paint
Super white
P / N 293 500 076

933

Sea-Doo
paint



F01B1Q4

APPLICATION

All models.

Spray paint for metallic parts only

A) White

926

P / N 293 500 029

B) Purple

930

P / N 293 500 020

Sea-Doo
paint



F01B0Q4

APPLICATION

A) Engine assembly.

B) Tuned pipe and muffler.

Gun Kote
Not sold by Bombardier

Kal-Gard
Coating & Mfg. Corp.

APPLICATION

Magneto and armature plate.

Gelcoat (liquid)

1 liter super white

943

P / N 293 500 075

APPLICATION

All models.

Epoxy glue
Not sold by Bombardier
3M-05900

APPLICATION

All models.

Gelcoat repair kit

945

P / N 295 500 216

APPLICATION

All models.

Loctite sealant
P / N 413 7103 00

961

APPLICATION

Exhaust system 787 engine.

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WATER-FLOODED ENGINE.....	02-03-1
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STORAGE.....	02-04-1

PERIODIC INSPECTION CHART

○ NOTE : Servicing period is given in hours. Shaded area shows the maintenance frequency.

DESCRIPTION	FREQUENCY			
	Every 10 hours	Every 25 hours	Every 50 hours	Every 100 hours or seasonally
Lubrication / corrosion protection of metallic components	①			
DESS operation / DESS post and safety lanyard cap terminal condition				
Engine ignition timing				
Spark plug replacement				
Throttle / choke cables, inspection / lubrication	①			
Flame arrester inspection				
Carburetor adjustment including choke / throttle cable adjustment and linkage				
Oil injection pump adjustment				
Fuel filter and oil filter inspection				
Fuel filter and oil filter replacement				
Engine head screws, retorque				
Steering system				
Throttle / shifter VTS controller inspection / adjustment				
Reverse system / reverse cable adjustment				
Fastener tightening (flame arrester(s), carburator(s), engine(s), exhaust system(s), etc.)				
Muffler(s), battery and reservoir fastening devices				
Fuel / oil lines, inspection, fuel system pressurization				
Inspect / clean engine drain hose(s)	①			
Bilge pump / deck drain hole inspection				
Battery condition				
Battery and starter cables				
Monitoring beeper / electrical connections				
Impeller shaft reservoir oil level / condition				Replace
Impeller condition and impeller / wear ring and clearance		②		
Drive shaft boot / spline condition (both ends)		②		
PTO flywheel lubrication				
Water intake grate condition		②		
Hull / ride shoe condition				
Cooling system flushing ③				
Zinc anodes				
Bilge air blower inspection				

① Every 10 hours in salt water use.

② These items have to be initially checked after 25 hours. Thereafter, servicing to be made as specified in this chart.

③ Daily flushing in salt water or foul water use.

FLUSHING AND CARE

FLUSHING

Flushing the cooling system with fresh water is essential to neutralize corroding effects of salt or other chemical products present in water. It will help to clear sand, salt, shells or other particles in water jackets (engine, exhaust manifold, tuned pipe) and / or hoses.

Flushing should be performed when the boat is not expected to be used further the same day or when the boat is stored for any extended time.

▼ **CAUTION :** Failure to flush cooling system, when necessary, will severely damage engine and / or exhaust system. Never flush a hot engine. Make sure engine operates during entire procedure.

PROCEDURE

◆ **WARNING :** Perform this operation in a well ventilated area. Do not touch any electrical parts or jet pump area when engine is running.

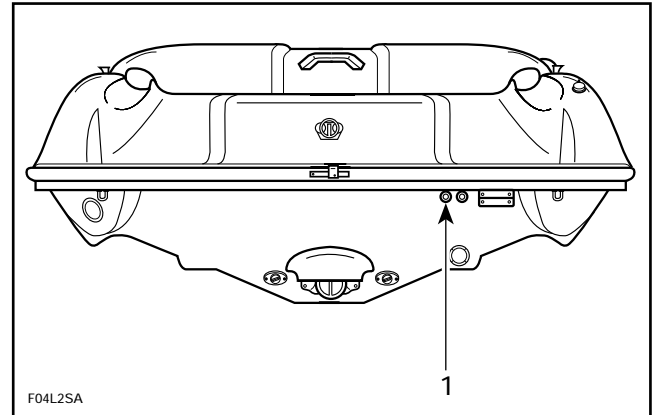
1. Clean jet pump by spraying water in its inlet and outlet and then spray a soapy solution.

◆ **WARNING :** Always remove safety lanyard cap from DESS post to prevent accidental engine starting before cleaning the jet pump area. Engine must not be running for this operation.

2. Open rear storage compartment and remove storage tray.

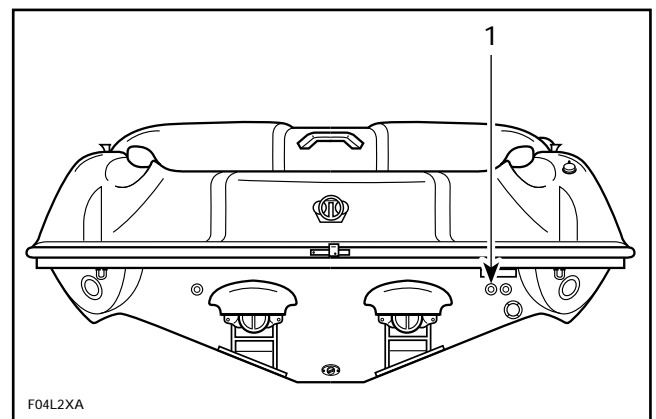
3. Connect a garden hose directly to the flushing connector. To prevent water leak, ensure the rubber washer is in the boat's connector.

Sportster and Challenger Models



1. Flushing connector

Speedster Model



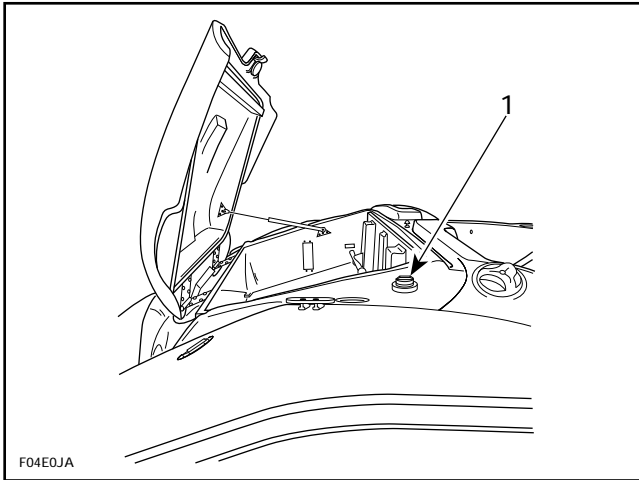
1. Flushing connector for port engine (LH side)
2. Flushing connector for starboard engine (RH side)

○ **NOTE :** On Speedster model, perform the operation on each engine.

The engine can also be flushed from the flushing connector that is located on the edge of the engine compartment. See illustration.

Section 02 MAINTENANCE

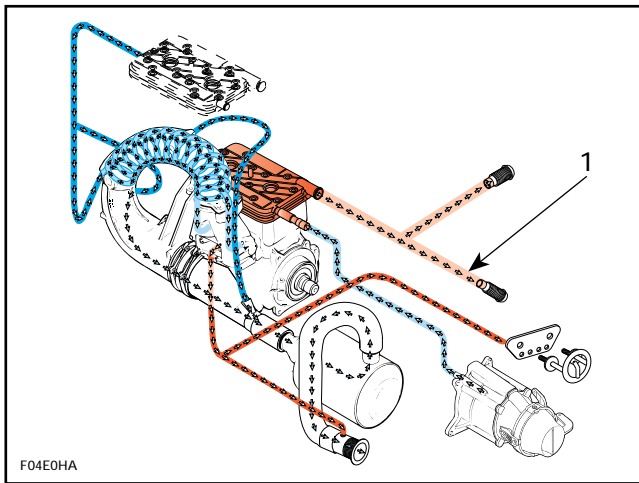
Sub-Section 02 (FLUSHING AND CARE)



1. Flushing connector with its cap

For proper flushing, it is necessary to prevent water going out directly by the flushing connector on the transom. Install a hose pincher (P / N 529 030 400) on the hose between the transom and the T-fitting as shown.

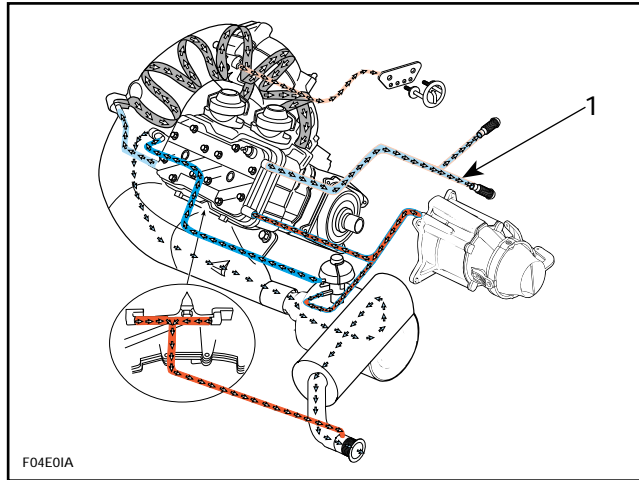
Sportster and Speedster



TYPICAL

1. Install a hose pincher in this section

Challenger



1. Install a hose pincher in this section

▼ **CAUTION** : Do not open water tap yet.

4. Start the engine then immediately open the water tap.

▼ **CAUTION** : Always start the engine before opening the water tap. Otherwise, water will back flow through the tuned pipe into the engine and may cause damage to internal parts. Open water tap immediately after engine is started to prevent overheating.

5. Run the engine about 3 minutes at a fast idle around 3500 RPM.

▼ **CAUTION** : Never run engine longer than 5 minutes. Drive line seal has no cooling when boat is out of water.

6. Close the water tap then stop the engine.

▼ **CAUTION** : Always close the water tap before stopping the engine. Follow this procedure exactly otherwise severe engine damage could occur.

7. Remove garden hose. Ensure the rubber washer remains in the boat's hose connector.

8. Wipe off any residual water on the engine(s).


9. Reinstall tray and close storage compartment cover.

CARE

1. Check joints for leaks to avoid water accumulation in the bilge.
2. Do not modify hose or socket size as coolant flow could be altered.
3. When engine is running, water must flow from bleed outlet(s) indicating that water circulates.
4. For hose clamp installation, use special pliers (P / N 295 000 070).
5. When installing hoses onto fittings or when troubleshooting for water intake in the bilge area, confirm that all hoses are properly secured to the fittings.
6. Check monitoring beeper operation by jumping terminal of thermosensor wire to ground. Beeper must operate.

At every verification of monitoring beeper always apply dielectric grease on thermosensor connector.

Verify wire terminal on connector for tightness. If too loose, squeeze terminal slightly at installation.

 **CAUTION :** When investigating for no water flow in the cooling system, check all elbows and straight fittings as well as all hoses for blockage.

WATER-FLOODED ENGINE

General

If engine is water-flooded, it must be serviced within a few hours after the event. Otherwise engine will have to be overhauled.

▼ **CAUTION :** A water-flooded engine must be properly lubricated, operated then lubricated again, otherwise parts will be seriously damaged.

Procedure

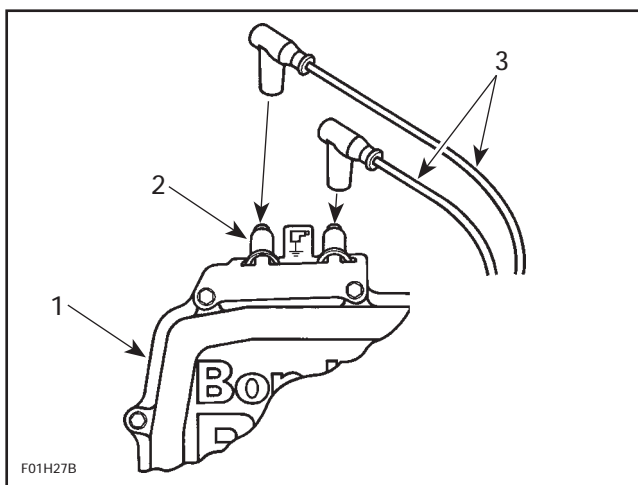
Check fuel and oil reservoirs for water contamination. If necessary, siphon and refill with fresh fluids.

Turn fuel valve(s) to OFF position then drain fuel filter bowl(s). Refer to FUEL SYSTEM, 06-01.

Drain bilge if water is present.

Remove spark plug cables and connect them on the grounding device.

◆ **WARNING :** Never crank engine with spark plugs removed unless spark plug cables are connected to the grounding device.



TYPICAL

1. Magneto housing
2. Grounding device
3. Spark plug cables

Remove spark plugs and dry them with a clean cloth. A contact cleaner spray can be used. It may be preferable to replace spark plugs. Do NOT install spark plugs on engine.

Crank engine(s) to drain crankcase.

▼ **CAUTION :** Be careful when cranking engine(s), water will spray out from spark plug holes.

Spray BOMBARDIER LUBE lubricant (P / N 293 600 006) into spark plug holes.

Crank engine(s) again.

Reinstall spark plugs and spark plug cables then safety lanyard cap on DESS post.

Turn fuel valve(s) to ON position.

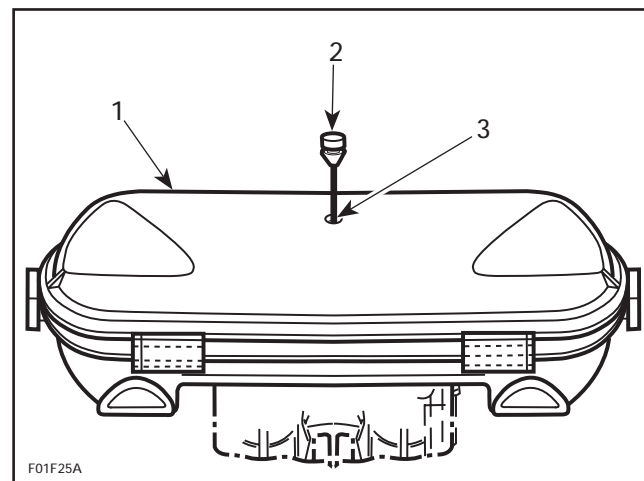
Start engine(s); It may be necessary to use the choke. If engine(s) do not start, repeat previous steps as necessary.

▼ **CAUTION :** To avoid starting motor overheating, the cranking period should not exceed 5-10 seconds and a rest period of 30 seconds should be observed between cranking cycles.

○ **NOTE :** If engine(s) do not start after several attempts, check ignition system for spark occurrence. Refer to ELECTRICAL SYSTEM, 08.

Check crankshaft if needed, it can become misaligned or deflected. Refer to ENGINE, 04-04.

After engine has started, spray BOMBARDIER LUBE lubricant through air intake silencer while engine is running.



1. Air intake silencer cover
2. Pull plug
3. Spray BOMBARDIER LUBE here

Run engine until it reaches its normal operating temperature.

Section 02 MAINTENANCE
Sub-Section 03 (WATER-FLOODED ENGINE)

▼ CAUTION : Water must be supplied to cool engine(s) through the boat's flushing connector(s).

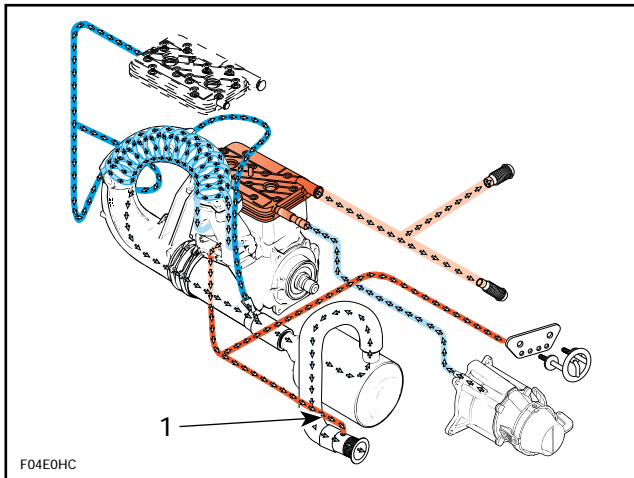
STORAGE

Engine Draining

Check engine drain hose running from engine manifold fitting to outlet socket. Make sure there is no sand or other particles in it and that it is not obstructed so that water can leave the engine. Clean hose and outlet socket as necessary.

▼ **CAUTION** : Water in engine drain hose must be free to flow out, otherwise water could be trapped in engine. Should water freeze in engine, severe damage will occur. Check engine drain hose for obstructions.

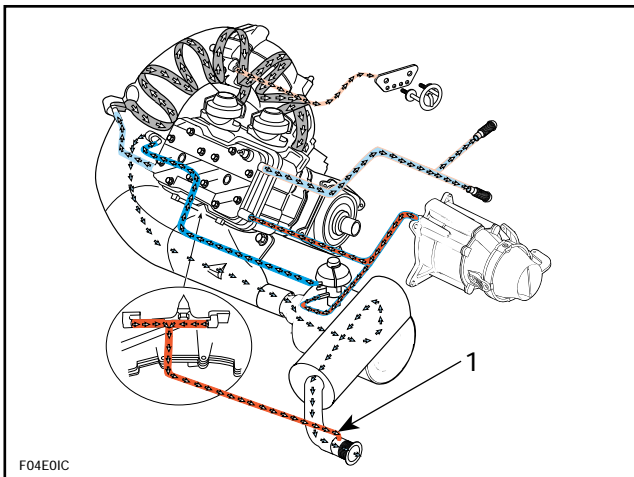
Sportster and Speedster



TYPICAL

1. Drain tube

Challenger



TYPICAL

1. Drain tube

Fuel System

Sea-Doo Fuel Stabilizer (P / N 413 408 600) can be added in fuel tank to prevent fuel deterioration and carburetor gumming. Follow manufacturer's instructions for proper use.

▼ **CAUTION** : Fuel stabilizer should be added prior engine lubrication to ensure carburetor protection against varnish deposit.

◆ **WARNING** : Fuel is flammable and explosive under certain conditions. Always work in a well ventilated area. Do not smoke or allow open flames or sparks in the vicinity. Always wipe off any fuel spillage from the boat.

Cooling System Flushing and Engine Internal Lubrication

Cooling system has to be flushed with fresh water to prevent salt, sand or dirt accumulation which will clog water passages. This will be achieved with a garden hose.

Refer to flushing, section 02-02 and follow the procedure.

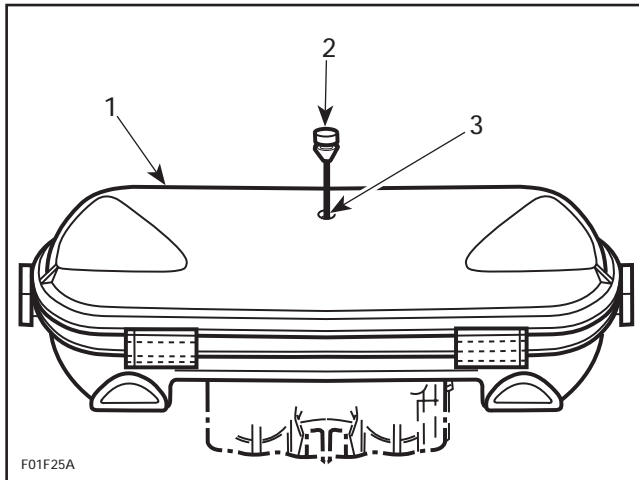
Internal Lubrication

Engine must be lubricated to prevent corrosion on internal parts. This will be achieved by spraying BOMBARDIER LUBE lubricant (P / N 293 600 006) through air intake silencer.

1. After the flushing procedure and the engine has been running as prescribed, spray BOMBARDIER LUBE lubricant through air intake silencer cover keeping engine at fast idle.

Section 02 MAINTENANCE

Sub-Section 04 (STORAGE)

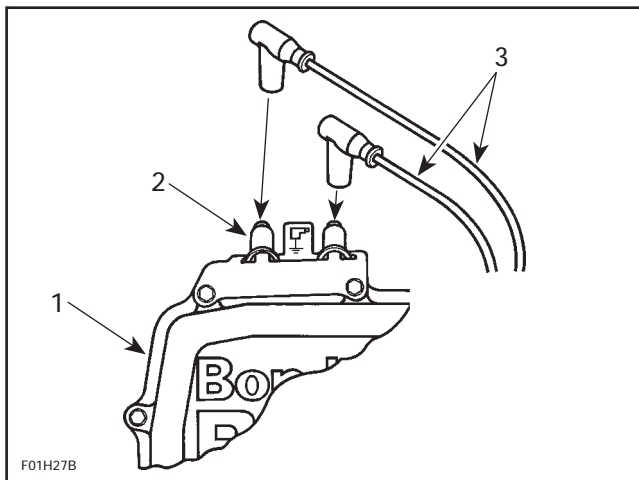


1. Air intake silencer cover
2. Pull plug
3. Spray BOMBARDIER LUBE here

Lubrication of engine should be done at least for 1 minute. After approximately half a minute, close fuel valve to run engine out of fuel while lubricating.

▼ **CAUTION :** When engine begins to run irregularly because of fuel starvation, immediately stop water flow before engine dies, otherwise severe engine damage could occur.

2. Close the water tap then stop the engine.
3. Remove garden hose from boat's connector. Ensure rubber washer remains in the connector.
4. Wipe up any residual water from the engine.
5. Remove spark plug cables and connect them on the grounding device.



TYPICAL

1. Magneto housing cover
2. Grounding device
3. Spark plug cables

6. Remove both spark plugs and spray BOMBARDIER LUBE lubricant into each cylinder.
7. Crank the engine a few turns to distribute the oil onto cylinder wall.
8. Apply antiseize lubricant (P / N 293 550 001) on spark plug threads then reinstall them.
9. Reinstall plug on air intake silencer cover.

▼ **CAUTION :** Do not run the engine during the storage period.

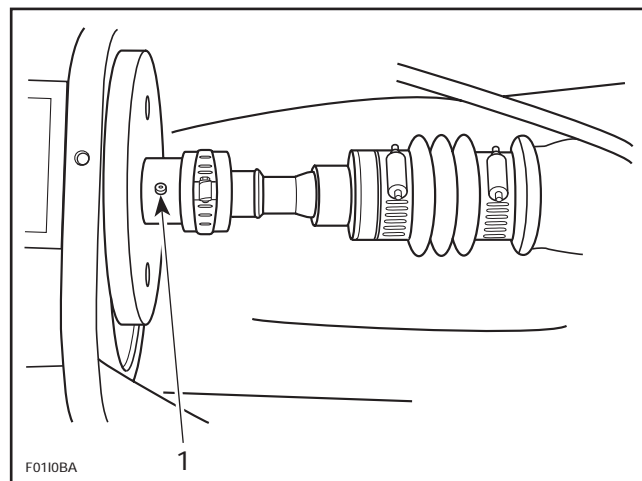
Propulsion System

Lubricant in impeller shaft reservoir should be drained. Reservoir should be cleaned and refilled with 90 mL (3 U.S. oz) of BOMBARDIER synthetic 75W 90 GL5 polyolester oil (P / N 293 600 011). Refer to PROPULSION AND DRIVE SYSTEMS 09-01.

▼ **CAUTION :** Use only BOMBARDIER jet pump oil or equivalent synthetic gear oil, otherwise component service life could be reduced. Do not mix oil brands or types.

Lubricate PTO flywheel at grease fitting with synthetic grease (P / N 293 550 010).

▼ **CAUTION :** Do not lubricate excessively. Immediately stop when a slight movement is noticed on rubber boot.



1. Grease PTO flywheel

▼ **CAUTION :** Never leave any clothing, tool or other objects in engine compartment.

Battery

For battery removal, cleaning and storage, refer to ELECTRICAL 08-03

Boat Cleaning

Clean the bilge with hot water and mild detergent or with bilge cleaner. Rinse thoroughly. Lift front end of boat to completely drain bilge. If any repairs are needed to body or to the hull, touch up paint and Gelcote® repair kit are available. Refer to SERVICE TOOLS AND PRODUCTS 01-02. Replace damaged labels / decals.

Wash the body with soap and water solution (only use mild detergent). Rinse thoroughly with fresh water. Remove marine organisms from the hull. Apply a nonabrasive wax.

▼ **CAUTION** : Never clean apparent fiberglass and plastic parts with strong detergent, degreasing agent, paint thinner, acetone, etc.

If the boat is to be stored outside, cover it with an opaque tarpaulin to prevent sun rays and grime from affecting the plastic components, boat finish as well as preventing dust accumulation.

The engine storage cover should be left opened during storage. Remove storage tray. Place it on deck. This will avoid engine compartment condensation and possible corrosion.

Unscrew the drain plugs for the storage, lift the boat so that the bow is higher than the stern. Safely block it in this position.

▼ **CAUTION** : The boat must never be left in water for storage. Never leave the boat stored in direct sunlight. UV radiation will dull finishes. Make sure to turn OFF bilge pump and blower.

Anticorrosion Treatment

Wipe off any residual water in the engine compartment.

Spray BOMBARDIER LUBE lubricant over all metallic components in engine compartment.

Lubricate the throttle cable with BOMBARDIER LUBE lubricant.

Unscrew the rear drain plug in order to avoid water build up in the bilge during rainfall. Tilt the boat to the rear so that water can flow out.

Additional Recommended Protection

In cool regions (where freezing point temperature may be encountered), cooling system should be filled with water and antifreeze solution. (40% water, 60% antifreeze).

▼ **CAUTION** : Always use ethylene-glycol anti-freeze containing corrosion inhibitors specifically recommended for aluminum engines.

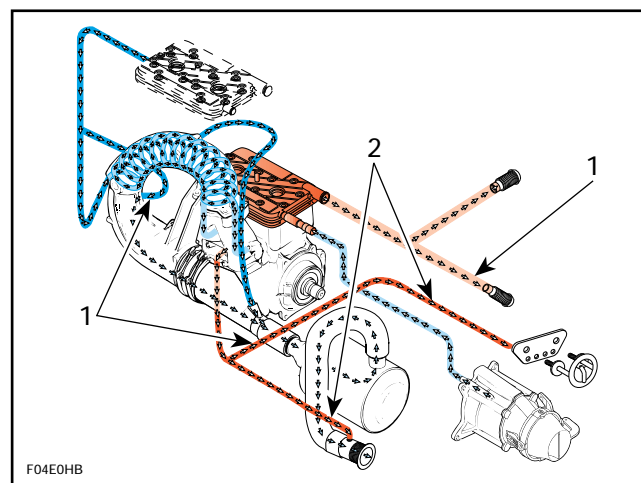
○ **NOTE** : The engine will not have to run during this operation.

Two hoses have to be disconnected to allow air to escape and antifreeze solution to completely fill cooling system water jackets.

Install a hose pincher on water injection hose, on the Cooling System Indicator (CSI) tube and outlet hose between T-fitting and transom.

Disconnect hoses where shown.

Sportster and Speedster



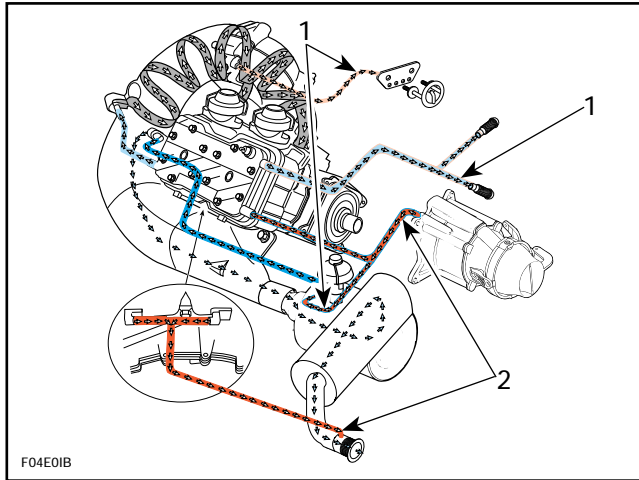
TYPICAL

1. Install a hose pincher on water injection hose, CSI hose and outlet hose between T-fitting and transom
2. Disconnect here

Section 02 MAINTENANCE

Sub-Section 04 (STORAGE)

Challenger



TYPICAL

1. Install a hose pincher on water injection hose, CSI hose and outlet hose between T-fitting and transom
2. Disconnect here

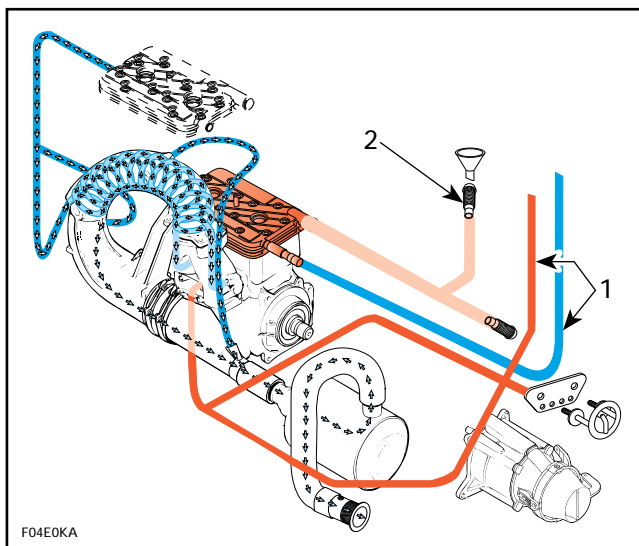
Raise all hoses above the highest point of tuned pipe and temporarily tie them together.

Unscrew cap and insert a funnel into the flushing fitting on the edge of the engine compartment. Pour about 2 liters (1/2 gal) of antifreeze solution through the funnel.

Tie up all hoses higher than tuned pipe.

NOTE : If hoses are not attached higher than tuned pipe, coolant will drain out.

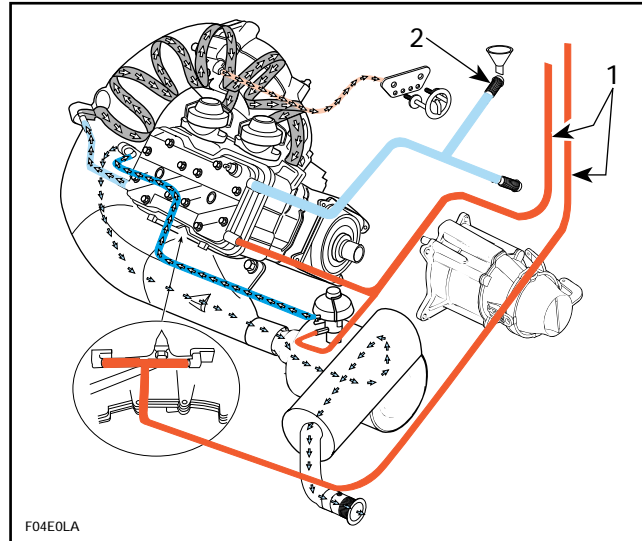
Sportster and Speedster



TYPICAL

1. Hold hoses higher than tuned pipe
2. Flushing fitting

Challenger Model



TYPICAL

1. Hold hoses higher than tuned pipe
2. Flushing fitting

The following steps should be performed to provide the boat enhanced protection.

Remove muffler and drain out as much water as possible. Reinstall muffler.

OR : Disconnect one hose from muffler and pour some antifreeze liquid inside muffler. Reconnect hose.

TROUBLESHOOTING

The following chart is provided to help in diagnosing the probable source of troubles. It is a guideline and should not be assumed to have all causes for all problems.

ENGINE WILL NOT START

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine does not turn over	<ul style="list-style-type: none"> • Battery connections • Safety lanyard cap worn or removed • Start / stop button defective • Burnt 5 A fuse (MPEM supply) • 5 A fuse keeps on burning (MPEM supply) • Discharged battery • Ignition switch not turned ON or defective • Water / fuel hydrolock • Starter or solenoid • Seized engine • Seized jet pump • Jammed pump 	<ul style="list-style-type: none"> • Turn to ON. Check, refer to section 08-05 • Replace / reinstall • Check, refer to section 08-05 • Check wiring then replace fuse • Check wiring and MPEM refer to section 08-05. Replace fuse • Check / recharge • Check / clean / tighten • Check, refer to section 02-03 • Check, refer to section 08-07 • Check / repair as needed • Check, refer to section 09-01 • Check / clean out debris
Engine slowly turns	<ul style="list-style-type: none"> • Discharged / weak battery • Battery connections • Restriction in jet pump • Seizure in jet pump • Seal carrier seizure • Partial engine hydrolock • Partial engine seizure • Worn starter • Wear ring improperly installed 	<ul style="list-style-type: none"> • Check / charge / replace • Check / tighten connections • Check / clean pump • Inspect, refer to section 09-01 • Check, refer to section 09-01 • Check, refer to section 02-03 • Check compression, refer to section 04-02 • Check, refer to section 08-07 • Check / replace, refer to section 09-01

Section 03 TROUBLESHOOTING

ENGINE WILL NOT START (CONT'D)

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Engine turns over	<ul style="list-style-type: none">• Fuel tank empty• Fuel water-contaminated• Dirty fuel filter• Fouled spark plugs• Water in engine• Misuse of choke (fuel flooded)• Carburetion• Ignition• Engine flooded — Needle valve stuck open• Choke(s) not closing completely• Excessive rotary valve clearance• Internal engine damage• Sheared flywheel key• Incorrect rotary valve timing	<ul style="list-style-type: none">• Refill• Renew supply• Clean / replace• Replace• Check, refer to section 02-03• Use only with cold engine• Check, refer to section 06-03• Check, refer to section 08-03 and 08-05• Check, refer to section 06-03• Adjust for complete closure• Check, refer to section 04-05• Check, refer to section 04-02 and 04-04• Check timing mark, refer to section 08-03• Check, refer to section 04-05
No spark at spark plugs	<ul style="list-style-type: none">• Grounded BLACK / RED / GREEN wire (additional BLACK / RED wire on twin engine models) connecting to MPEM• Unproperly grounded MPEM BLACK wire• Defective MPEM• Faulty magneto system	<ul style="list-style-type: none">• Repair• Repair• Check, refer to section 08-05• Check wiring and ignition system, refer to section 08-03

ENGINE MISFIRES, RUNS IRREGULARLY

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Weak spark	<ul style="list-style-type: none"> Fouled, defective, worn spark plugs Faulty MPEM or start / stop switch Faulty ignition Sheared flywheel key 	<ul style="list-style-type: none"> Check / verify heat range / gap /replace Check, refer to section 08-05 Check, refer to section 08-03 Check timing mark, refer to section 08-03
Lean fuel mixture Dry spark plug (except when water fouled)	<ul style="list-style-type: none"> Fuel level low Stale or water fouled fuel Fuel filter dirty or restricted Carburetion dirty or out of adjustment Leaking crankshaft seal(s), rotary valve cover O-ring(s) Fuel valve restricted or partially opened Loose carburetor 	<ul style="list-style-type: none"> Check / refill Check / siphon and refill Check / clean / replace Check / clean / adjust, refer to section 06-03 Check / test / replace, refer to engine section 04-04 and 04-05 Check / replace / turn fully ON Tighten carburetor(s)
Rich fuel mixture Fouled spark plug	<ul style="list-style-type: none"> Partially closed choke Flame arrester dirty or restricted Carburetor adjustment or setting Main jet loose Main jet O-ring damage Rotary valve shaft seal leaking Oil pump adjustment Boat transportation Worn needle(s) and seat(s) Excessive rotary valve clearance 	<ul style="list-style-type: none"> Check / adjust choke cable Check / clean / replace Check / clean / adjust, refer to section 06-03 Check, refer to section 06-03 Check / replace, refer to section 06-03 Check / replace, refer to section 04-05 Check / adjust, refer to section 07-02 Turn fuel valve to OFF Check, refer to section 06-03 Check, refer to section 04-05
Difficult to start	<ul style="list-style-type: none"> Incorrect rotary valve timing Excessive rotary valve clearance 	<ul style="list-style-type: none"> Check / adjust, refer to section 04-05 Check, refer to section 04-05

ENGINE OVERHEATS

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Monitoring beeper continuously sounds	<ul style="list-style-type: none"> Restricted jet pump water intake Cooling system restriction Grounded temperature sensor or sensor wire 	<ul style="list-style-type: none"> Check / clean Check / flush, refer to section 02-02 Check / repair / replace

Section 03 TROUBLESHOOTING

ENGINE CONTINUALLY BACKFIRES

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Weak spark	<ul style="list-style-type: none">• Fouled, defective spark plugs• MPEM malfunction	<ul style="list-style-type: none">• Clean / replace• Check, refer to section 08-05
Ignition timing	<ul style="list-style-type: none">• Incorrect setting• Flywheel key sheared	<ul style="list-style-type: none">• Check / reset, refer to section 08-03• Check / replace
Rotary valve	<ul style="list-style-type: none">• Timing incorrect	<ul style="list-style-type: none">• Check / reset, refer to section 04-05
Carburetor	<ul style="list-style-type: none">• Carburetion too lean	<ul style="list-style-type: none">• Check / adjust, refer to section 06-03
Engine	<ul style="list-style-type: none">• Intake leak / crankshaft seal failure	<ul style="list-style-type: none">• Pressure check engine to 48 kPa(7 PSI)

ENGINE DETONATION OR PINGING

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Ignition	<ul style="list-style-type: none">• Timing too far advanced• Spark plug heat range too high	<ul style="list-style-type: none">• Check / reset• Check / change to correct range
Engine temperature	<ul style="list-style-type: none">• Engine overheating• Poor quality fuel	<ul style="list-style-type: none">• Check, refer to section 02-03 and 05-01 or to engine overheat• Use good quality fuel

ENGINE LACKS ACCELERATION OR POWER

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	<ul style="list-style-type: none">• Weak spark• Carburetion, jetting too rich / lean• Throttle does not open fully• Low compression• Exhaust system restriction• Water in gas or oil• Debris in needle valve• Jet pump related problem• Twisted crankshaft• Cooling system water flow regulator valve (challenger only)	<ul style="list-style-type: none">• Check / replace, refer to section 08-03• Check / adjust, refer to section 06-03• Check / readjust• Check / repair, refer to section 04-02• Check / clean• Check / siphon / replace• Check / clean, refer to section 06-03• Refer to "POOR START, ACCELERATION OR PERFORMANCE OF BOAT" below• Check, refer to section 04-04• Check / adjust, refer to section 05-01

POOR START, ACCELERATION OR PERFORMANCE OF BOAT

OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
Jet pump cavitation : <ul style="list-style-type: none"> • Poor start / acceleration of boat • Poor top performance of boat and / or stator vanes erosion 	<ul style="list-style-type: none"> • Trailing edge of impeller is damaged • Leading edge of impeller is damaged 	<ul style="list-style-type: none"> • Check / Replace • Check / Replace
Jet pump ventilation : Engine RPM is high and boat is slow to accelerate OR engine does not react quickly when pushing on throttle lever (assuming that engine is correct) OR engine does not keep a steady top RPM (assuming that engine is correct)	<ul style="list-style-type: none"> • Pump improperly sealed to ride shoe; insufficient sealant on the ride shoe or missing neoprene seal • Through-hull seal around drive shaft ; air comes from inside the boat • Retaining screws of ride shoe; air comes from inside the boat. • Retaining screws of intake grate; air comes from inside the boat. 	<ul style="list-style-type: none"> • Check / Reseal / Install a new neoprene seal • Check / Replace • Check / Reseal • Check / Reseal
Other problem with jet pump (related to performance) : Boat does not reach its top speed	<ul style="list-style-type: none"> • A wear ring with excessive clearance • A damaged or worn pump housing • A damaged impeller • An impeller with the wrong pitch (too low) • Missing or damaged impeller boot • Weeds or debris in intake grate • Weeds or debris in intake grate 	<ul style="list-style-type: none"> • Check / Replace • Check / Replace • Check / Replace • Check / Replace • Check / Install • Check / Clean • Check / Clean

ABNORMAL NOISE FROM PROPULSION SYSTEM

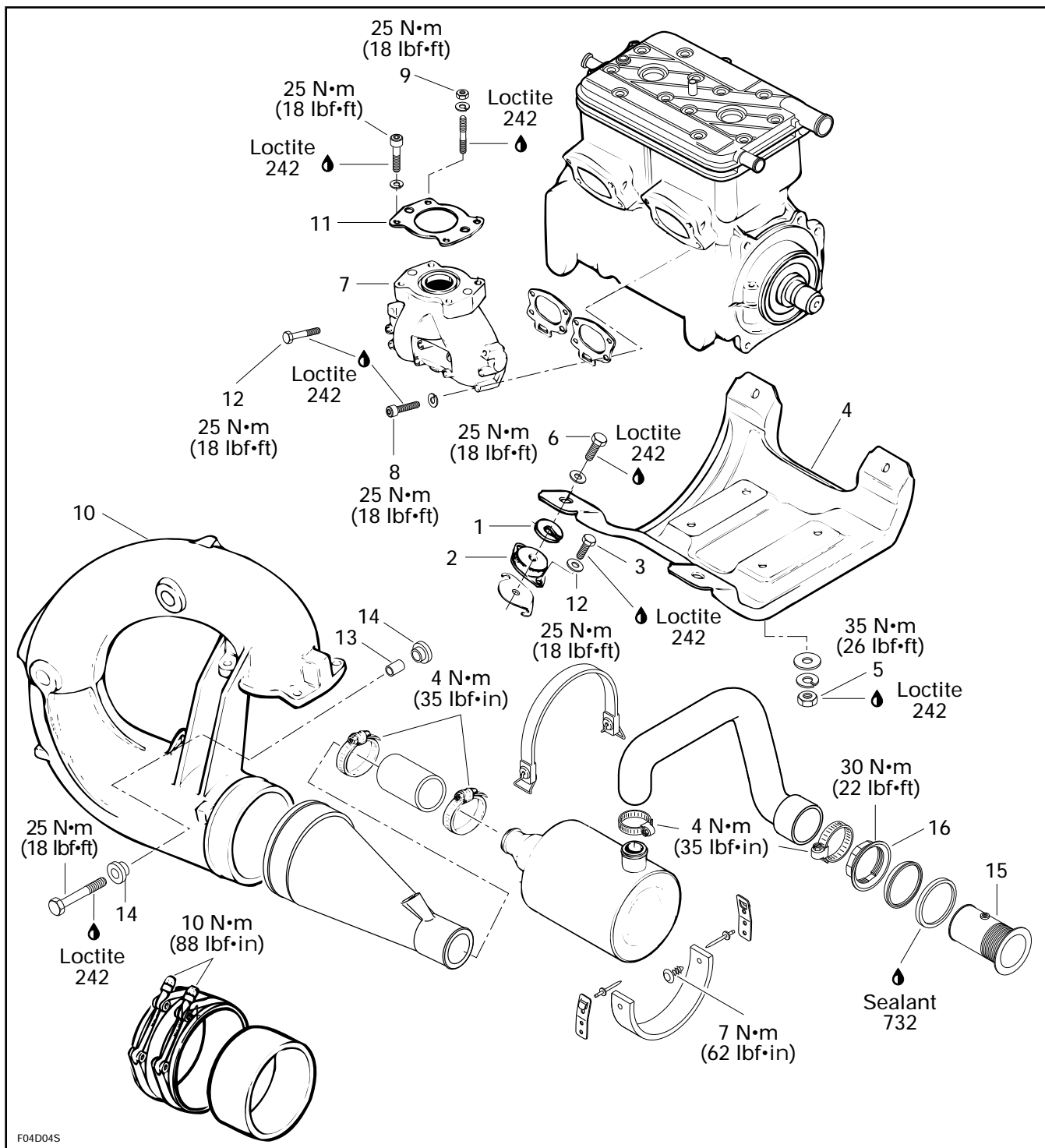
OTHER OBSERVATION	POSSIBLE CAUSE	REMEDY
	<ul style="list-style-type: none"> • Weeds / debris caught in pump intake or impeller • Low oil level in pump housing • Damaged or bent drive shaft • Broken motor mounts • Rusted / worn hull seal carrier 	<ul style="list-style-type: none"> • Check / clean • Check / troubleshoot source of leak / refill supply, refer to section 09-01 • Check / replace, refer to section 09-01 • Check / replace, refer to section 04-01 • Check / repair, refer to section 09-01

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REMOVAL AND INSTALLATION

717 Engine

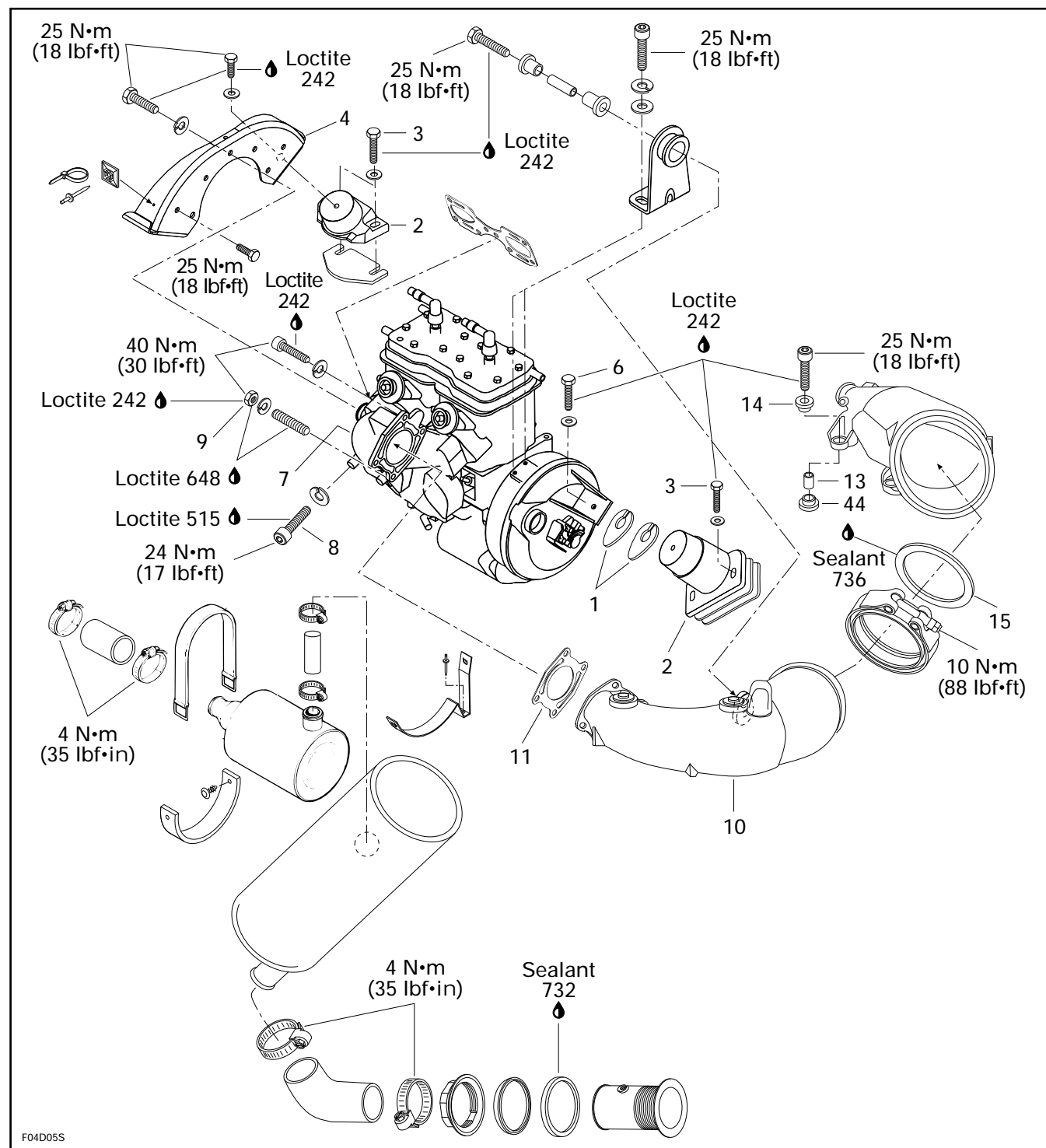


NOTE : Some numbers are missing. They are used on the next illustration.

Section 04 ENGINE

Sub-Section 01 (REMOVAL AND INSTALLATION)

787 Engine



○ NOTE : Some numbers are missing. They are used on the previous illustration.

GENERAL

It is not necessary to remove engine from jet boat for TOP END nor PTO FLYWHEEL AND MAGNETO servicing. However engine removal is necessary to repair BOTTOM END AND ROTARY VALVE.

Speedster Model

Although that basically the same engines are used for port and starboard, there are differences in hardware such as, choke / throttle cable lengths, fuel / oil lines, electrical wiring etc. Properly identify engines prior to removal.

REMOVAL FROM JET BOAT

○ **NOTE :** To ease working in engine compartment, it is suggested to remove rear storage compartment cover from boat.

In order to remove engine from jet boat proceed as follows.

▼ **CAUTION :** Whenever removing engine from jet boat, engine / jet pump alignment must be performed.

Jet Pump Removal

To withdraw jet pump unit ass'y, refer to PROPULSION AND DRIVE SYSTEMS, 09-01 then refer to Jet Pump Removal.

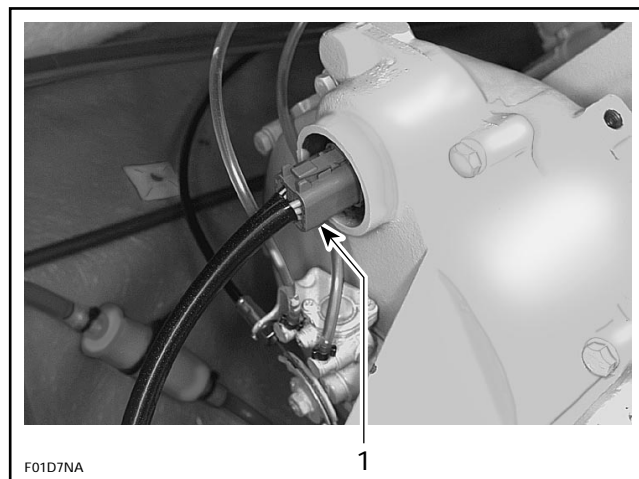
Electrical Connections

◆ **WARNING :** Always disconnect starter or battery cables exactly in the specified order, BLACK negative cable first. Electrolyte or fuel vapors can be present in the engine compartment and a spark might ignite them and possibly cause personal injuries. It is recommended to disconnect electrical connections prior to disconnecting fuel lines.

First, remove BLACK negative cable from battery(ies), then RED positive cable.

Disconnect thermosensor wire(s) and spark plug cables.

Disconnect magneto wires at connector of engine.



787 ENGINE SHOWN

1. Connector

Disconnect cooling system hoses from engine head.

Disconnect bleed hose at T-fitting close to engine.
Disconnect muffler from tuned pipe.

Fuel System

Turn fuel valve to OFF position.

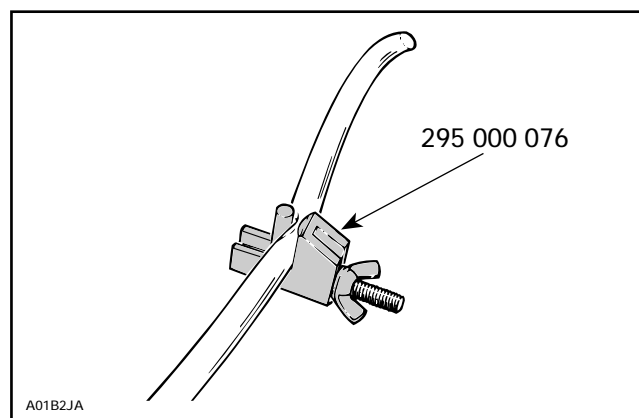
Disconnect fuel supply line from carburetor.

Disconnect fuel return line from carburetor.

Disconnect throttle and choke cables from carburetor.

Oil System

To prevent excessive oil spillage, use a hose pincher (P / N 295 000 076).



TYPICAL

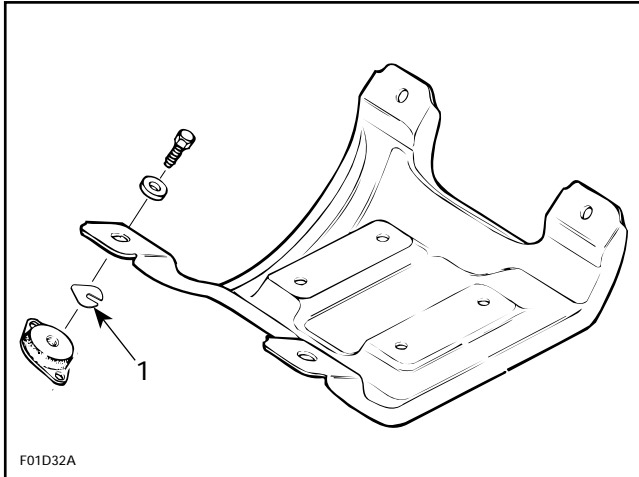
Section 04 ENGINE

Sub-Section 01 (REMOVAL AND INSTALLATION)

Engine Support Mounts

Remove engine support mount screws.

NOTE : Be careful when removing engine support mount screws, shims could have been installed between engine support and rubber mounts. To ease engine / jet pump alignment, indicate shim location for reinstallation.



TYPICAL - 717 ENGINE SUPPORT SHOWN

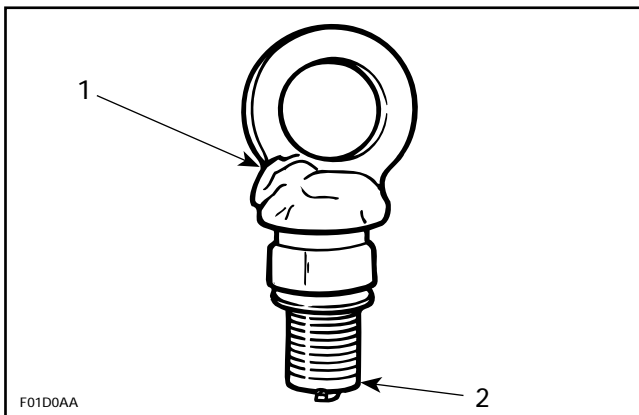
1. Shim

Lifting Engine

717 Engine

Engine can be easily lifted using the following suggested tools.

- Cut porcelain from 2 old spark plugs.
- Weld a lock washer approximately 20 mm diameter on each spark plug as shown.



1. Weld a lock washer here
2. Old spark plug

Remove spark plugs and replace by special tools.

Hook a sling into holes of special tools then using a chain block, a hoist or other suitable equipment, slowly lift engine.

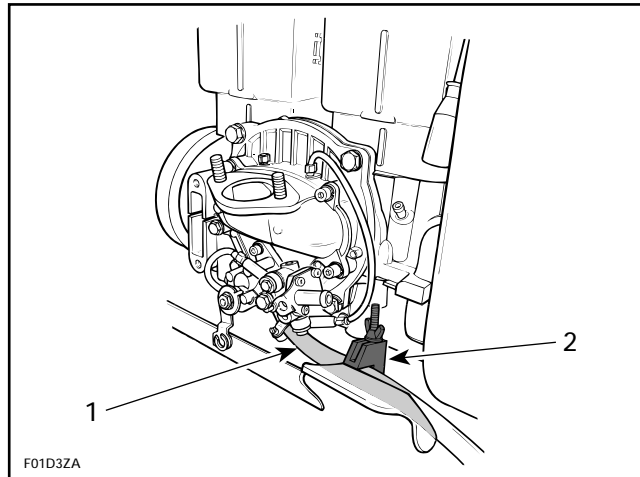
787 Engine

Engine can be easily lifted by inserting a hook into exhaust manifold eyelet.

All Models

Lift engine until oil pump supply line, rotary valve oil lines (supply and return) are reachable. Install a hose pincher on each line then disconnect.

Disconnect RED positive cable from starter post and ground cable (where applicable).



TYPICAL - 717 ENGINE SHOWN

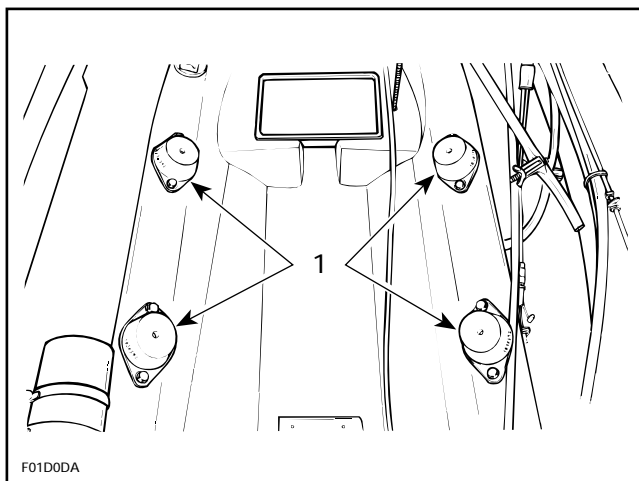
1. Rotary valve supply line
2. Hose pincher installed

Carefully lift engine out of boat.

CAUTION : Be careful not to scratch body with engine support or to hit any component.

1,2, Shim and Rubber Mount

Do not remove engine rubber mounts needlessly. They sit on shims which control engine / jet pump alignment. Alignment has been set at the factory. Always remove rubber mounts one at a time and reinstall each shim to its original location.



TYPICAL - 717 ENGINE MOUNTS SHOWN

1. Do not remove rubber mounts needlessly

▼ **CAUTION** : If shims with different thickness are interchanged, engine and jet pump will be misaligned.

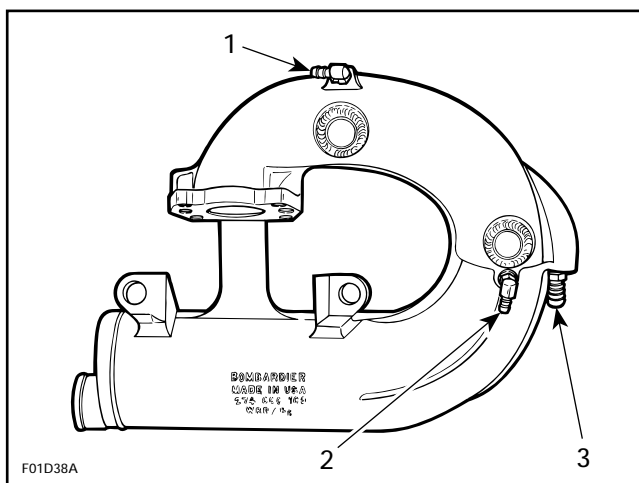
○ **NOTE** : If shims location have been mixed up or whenever removing the engine always use engine / jet pump alignment tool (P / N 295 000 089) to check alignment.

Tuned Pipe Removal

717 Engine

Disconnect hoses from water inlet hose fitting, injection hose and bleed hoses from tuned pipe and engine.

Cut tie rap retaining BLACK negative cable to water injection hose.



TYPICAL

1. Bleed hose removed
2. Injection hose removed
3. Inlet hose removed

Remove tuned pipe retaining screw from exhaust manifold side.

Remove tuned pipe mounting screws and nut from top of exhaust manifold.

○ **NOTE** : Slightly lift tuned pipe to release nut as necessary.

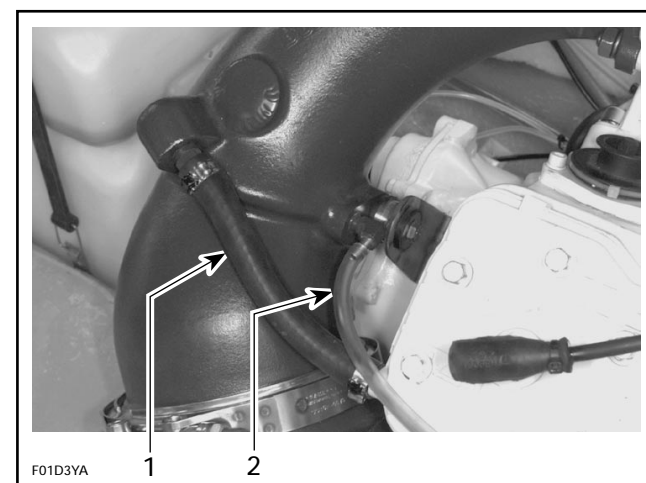
Withdraw tuned pipe.

Disconnect drain hose on exhaust manifold fitting.

Remove exhaust manifold.

787 Engine

Disconnect water supply hose and water injection hose at tuned pipe head.

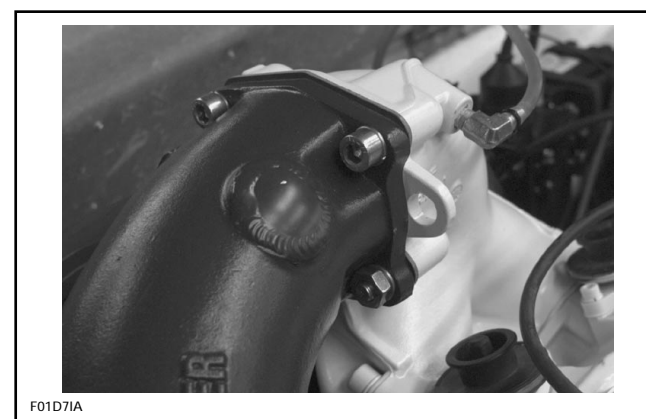


1. Water supply hose
2. Water injection hose

Slacken exhaust hose collar at tuned pipe cone outlet.

Remove clamp securing tuned pipe cone to tuned pipe head.

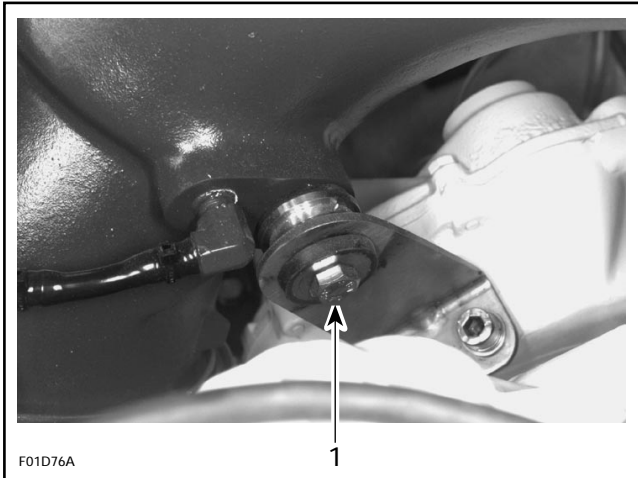
Remove screws and nut with lock washers at tuned pipe head flange.



Section 04 ENGINE

Sub-Section 01 (REMOVAL AND INSTALLATION)

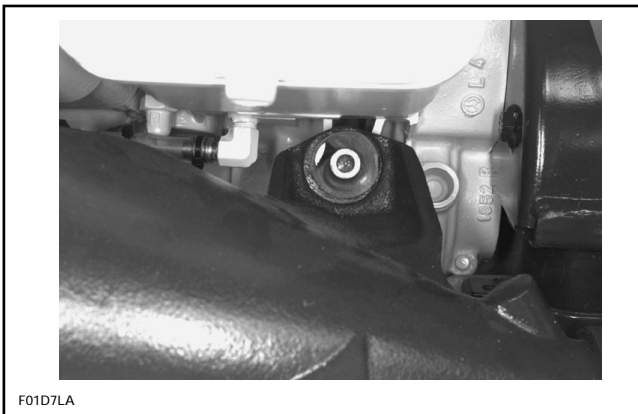
Remove retaining screw of tuned pipe head.



1. Screw

Remove tuned pipe head.

Remove 2 screws retaining tuned pipe cone to engine.



Remove tuned pipe cone.

Remove intake silencer and flame arrester base.
Refer to next page.

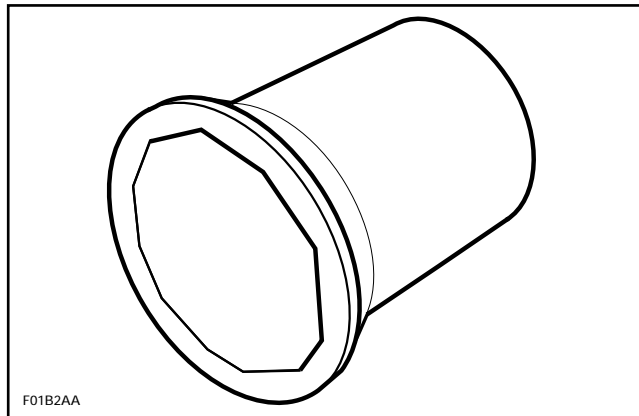
Remove carburetors. Refer to FUEL SYSTEM, CARBURETORS 06-03 for proper procedure.

Remove 8 screws and lock washers then withdraw exhaust manifold.

15,16, Exhaust Outlet and Nut

Sportster / Speedster

To unscrew / screw the nut, use the exhaust outlet tool (P / N 295 000 132).



TUNED PIPE REPAIR

All Models

This procedure is given to repair tuned pipe cracks using T.I.G. welding process.

Procedure

- Sand the cracked area to obtain bare metal.
- Perform a 1.50 mm (1/16 in) depth chamfer over crack.
- Use pure argon gas with 5.55 mm (3/32 in) tungsten electrode (puretung "green", zirtung "brown") and AC current.
- Use aluminum welding rod 5.55 mm (3/32 in) (no. 4043), to fill crack.
- Sand welding slightly to remove material surplus.

Test :

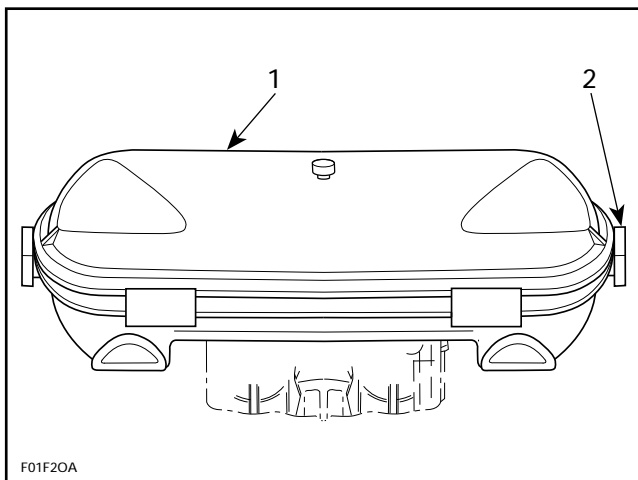
- Use compressed air at 124 kPa (18 PSI) to pressurize tuned pipe.

○ **NOTE :** Prior to verify leaks, plug all holes and pressurize tuned pipe while immersing it in water.

▼ **CAUTION :** Always ensure water passages are not blocked partially or completely while welding tuned pipe.

Air Intake Silencer Removal

Unlock retaining slides holding air intake silencer cover and remove cover.



TYPICAL

1. Air intake silencer cover
2. Unlock

Remove flame arrester retainer screws ; then, remove air intake silencer base.

Flame Arrester Base Removal

Remove screws holding flame arrester base support to the cylinder head cover.

Remove flame arrester.

Remove screws from flame arrester base then withdraw base.

CLEANING

Wipe off any spillage in bilge. Clean with a bilge cleaner.

Discard all gaskets and O-rings.

Clean external parts of engine.

INSTALLATION

Installation of engine in jet boat is essentially the reverse of removal procedures. However pay particular attention to the following.

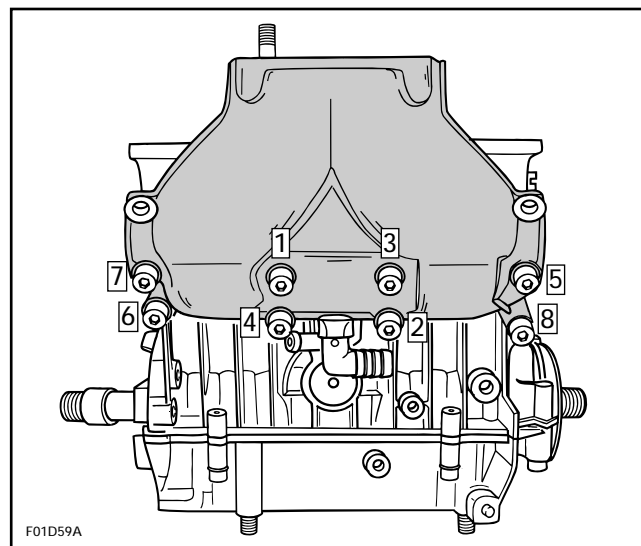
7,18, Exhaust Manifold and Screw

Apply Loctite 242 (blue) on screw threads. (717 engine).

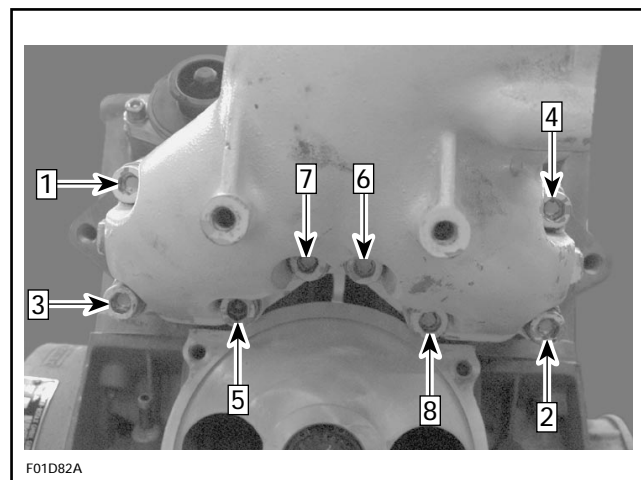
Apply Loctite 515 on screw threads (787 engine).

Install and torque exhaust manifold screws to 12 N•m (9 lbf•ft) as per following illustrated sequence. Repeat the procedure, retightening screws to 24 N•m (17 lbf•ft).

717 Engine



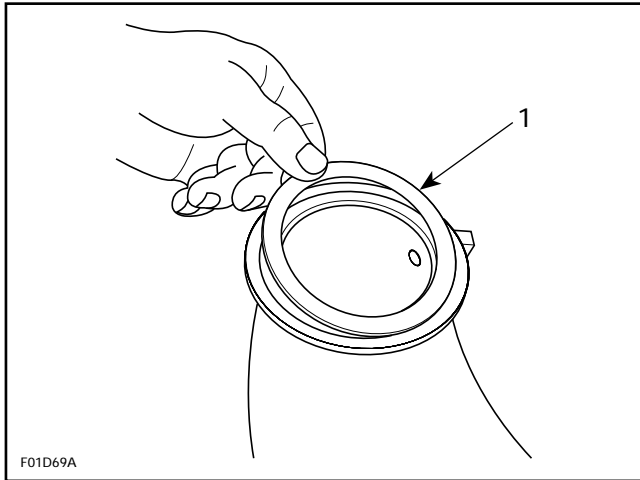
787 Engine



Make sure to install sealing ring on tuned pipe cone.

Section 04 ENGINE

Sub-Section 01 (REMOVAL AND INSTALLATION)



TYPICAL

1. Sealing ring

Apply a thin layer of heat resistant sealant (P / N 413 709 200) all around sealing ring.

Refer to the main illustration at the beginning of this sub-section for torque specifications and products to be used.

9,10,11,12,13,14, Nut, Tuned Pipe, Gasket, Screw, Sleeve and Rubber Bushing

717 Engine

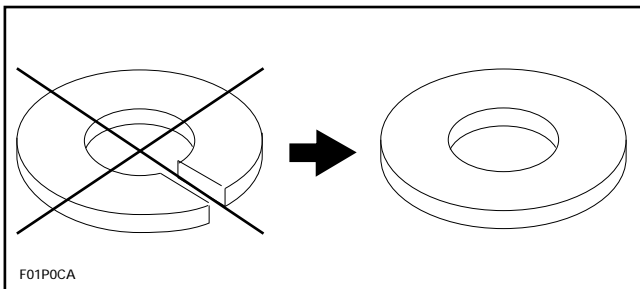
Make sure that gasket is properly located on exhaust manifold prior to finalizing pipe installation.

Ensure rubber bushings and sleeve are not damaged and are properly installed into tune pipe support(s).

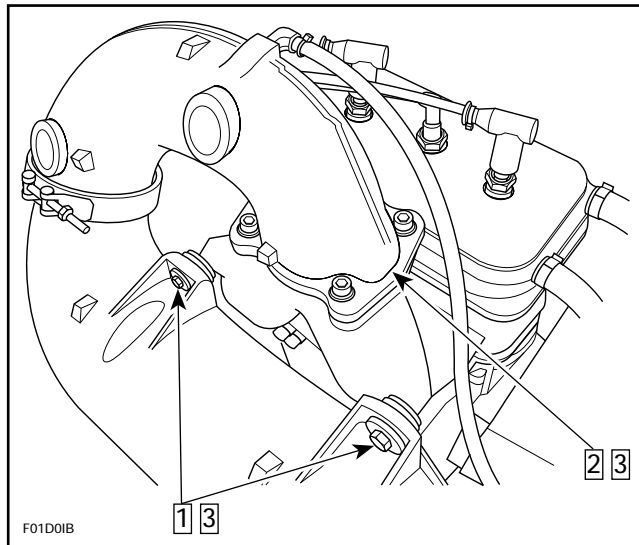
CAUTION : Damage to bushings and / or sleeve will eventually cause stress to tune pipe and may cause cracking.

Apply Loctite 242 (blue) on stud and retaining screw threads. Hand-tighten nut and top screws only and assure that tuned pipe bushing(s) rests against manifold.

Use 8 mm flat washers (P / N 293 050 001) at tuned pipe flange instead of lock washers.



Refer to the following illustration for the torquing sequence.



TYPICAL

Step 1 : Torque screws of tuned pipe to 12 N•m (9 lbf•ft)

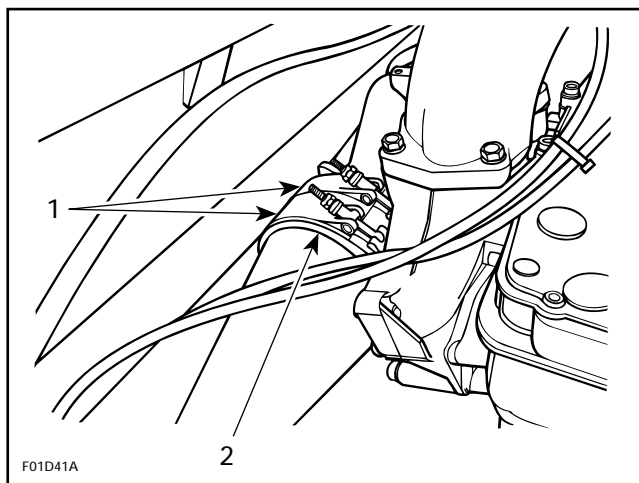
Step 2 : Torque nut and screws of tuned pipe flange in a criss-cross sequence to 12 N•m (9 lbf•ft)

Step 3 : Repeat the torquing sequence by retightening all fasteners to 25 N•m (18 lbf•ft)

CAUTION : This installation procedure will im-prove the durability of the assembly and prevent breakage of stud and screws.

Install tuned pipe cone with collar and clamp.

Position clamp as illustrated. Do not tighten clamp yet.



TYPICAL

1. Clamp
2. Exhaust collar

With hose removed, align cone outlet with muffler inlet.

○ **NOTE** : Due to exhaust cone angle, it may have to be rotated to obtain alignment.

Push cone until it touches tuned pipe, then tighten exhaust collar clamp and torque to 10 N•m (88 lbf•in).

▼ **CAUTION** : There must be no gap between tuned pipe cone and tuned pipe head.

○ **NOTE** : Exhaust collar clamp nuts should be tightened alternatively to assure no leakage and to obtain specified torque.

2,3, Rubber Mount and Screw

All Engines

Check tightness and condition of rubber mounts. If they have been removed, apply Loctite 242 (blue) on screw threads. Torque screws to 25 N•m (18 lbf•ft).

▼ **CAUTION** : Strict adherence to this torque is important to avoid damaging threads of aluminum insert in bilge.

4,5, Engine Support and Nut

Properly install support on crankcase so that rounded portion of support matches with MAG side of crankcase. Apply Loctite 242 (blue) on threads then torque nuts in a criss-cross sequence to 35 N•m (26 lbf•ft).

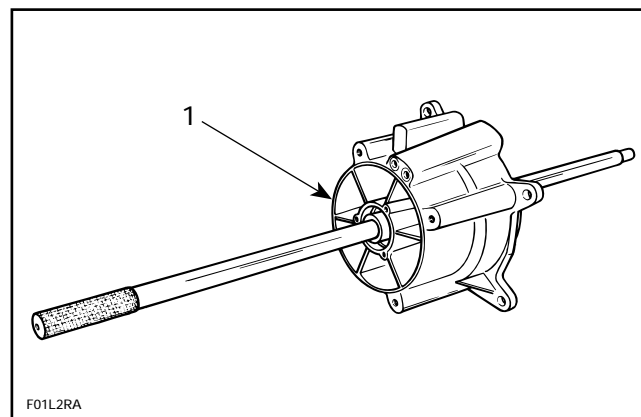
Electric Cables, Oil Pump / Rotary Valve Supply and Return Lines

Make sure to reinstall lines and electric cables before completely lowering engine in bilge.

○ **NOTE** : If fuel line ends are damaged, cut damaged ends before reinstallation. For fuel line clamping, use special pliers (P / N 295 000 054).

Engine / Jet Pump Alignment

Alignment is necessary to eliminate possible vibration and / or damage to components. Check alignment of engine using alignment tool.

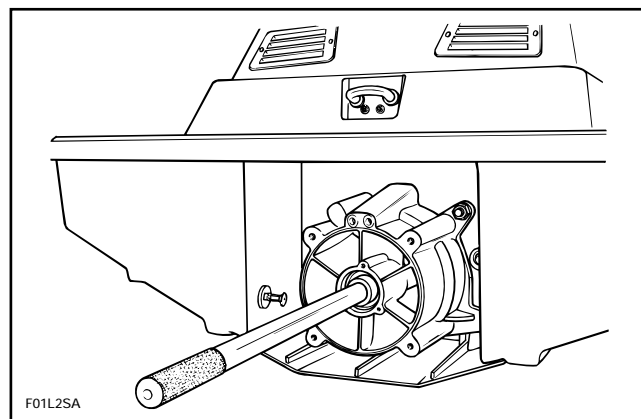


1. Alignment tool (P / N 295 000 089)

▼ **CAUTION** : Some jet boats require a shim between hull and pump ; if shim has been removed at time of pump disassembly, ensure to reinstall it. If not reinstall, engine and jet pump alignment will be altered.

To verify alignment proceed as follows:

- Install housing on hull with 4 nuts.
- Carefully slide shaft through housing and seal carrier. Pay attention not to hit PTO flywheel.



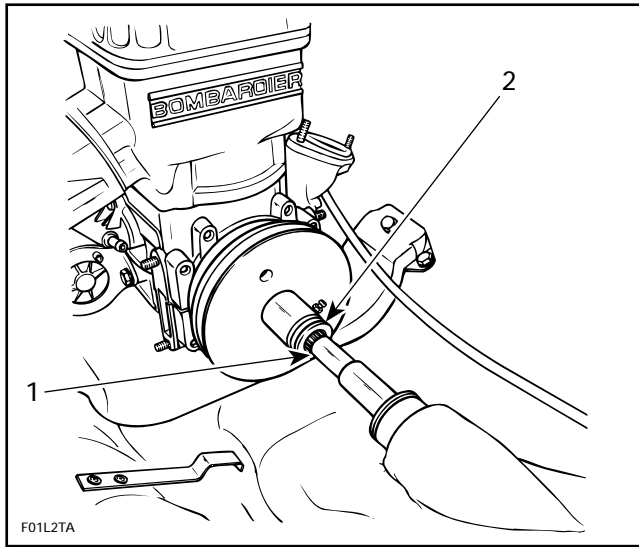
TYPICAL

- Insert shaft end into PTO flywheel.

○ **NOTE** : If the alignment is correct, the shaft will slide easily without any deflection in PTO flywheel splines.

Section 04 ENGINE

Sub-Section 01 (REMOVAL AND INSTALLATION)

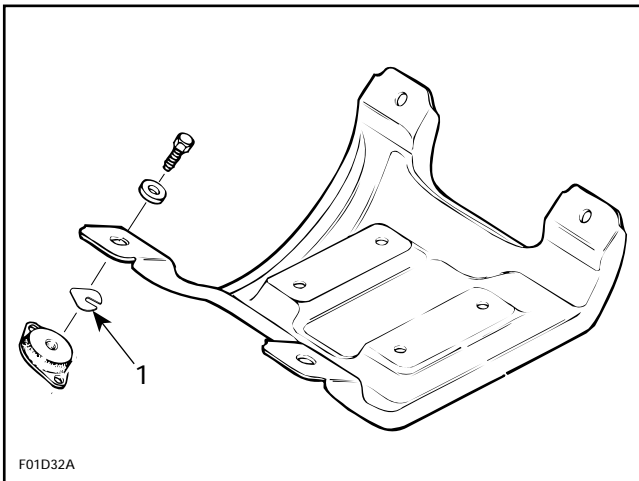


TYPICAL - 717 ENGINE SHOWN

1. Shaft end
2. PTO flywheel

If the alignment is incorrect loosen engine support screws to enable to align PTO flywheel with shaft end.

○ **NOTE :** Use shim(s) (P / N 270 000 024) or (P / N 270 000 025) as necessary between engine support and rubber mounts to correct alignment.



TYPICAL - 717 ENGINE SUPPORT SHOWN

1. Shim

▼ **CAUTION :** Whenever shims are used to correct alignment, never install more than 6 mm (0.240 in) shim thickness. If alignment cannot be obtained verify for engine support bending.

6, Screw and Loctite 242 (Blue)

Apply Loctite 242 (blue) on screw threads.

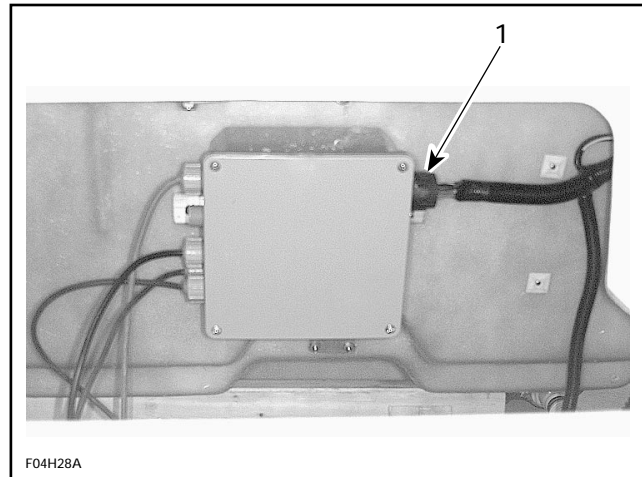
Retorque engine support screws to 25 N•m (18 lbf•ft) when procedure is completed.

○ **NOTE :** Whenever alignment tool is not utilized, apply BOMBARDIER LUBE lubricant on its shaft and inside the housing to eliminate possible corrosion.

Electrical Connections

Properly resecure electrical wires / cables.

◆ **WARNING :** To prevent any possible spark that may occur at the battery terminals while connecting the cables, unscrew and disconnect the connector at the electrical box PRIOR TO CONNECTING THE BATTERY CABLES.



1. Electrical box connector

After connecting the battery, reinstall the electrical box connector.


◆ **WARNING :** Always connect RED positive cable first then BLACK negative cable last.

Final Inspection

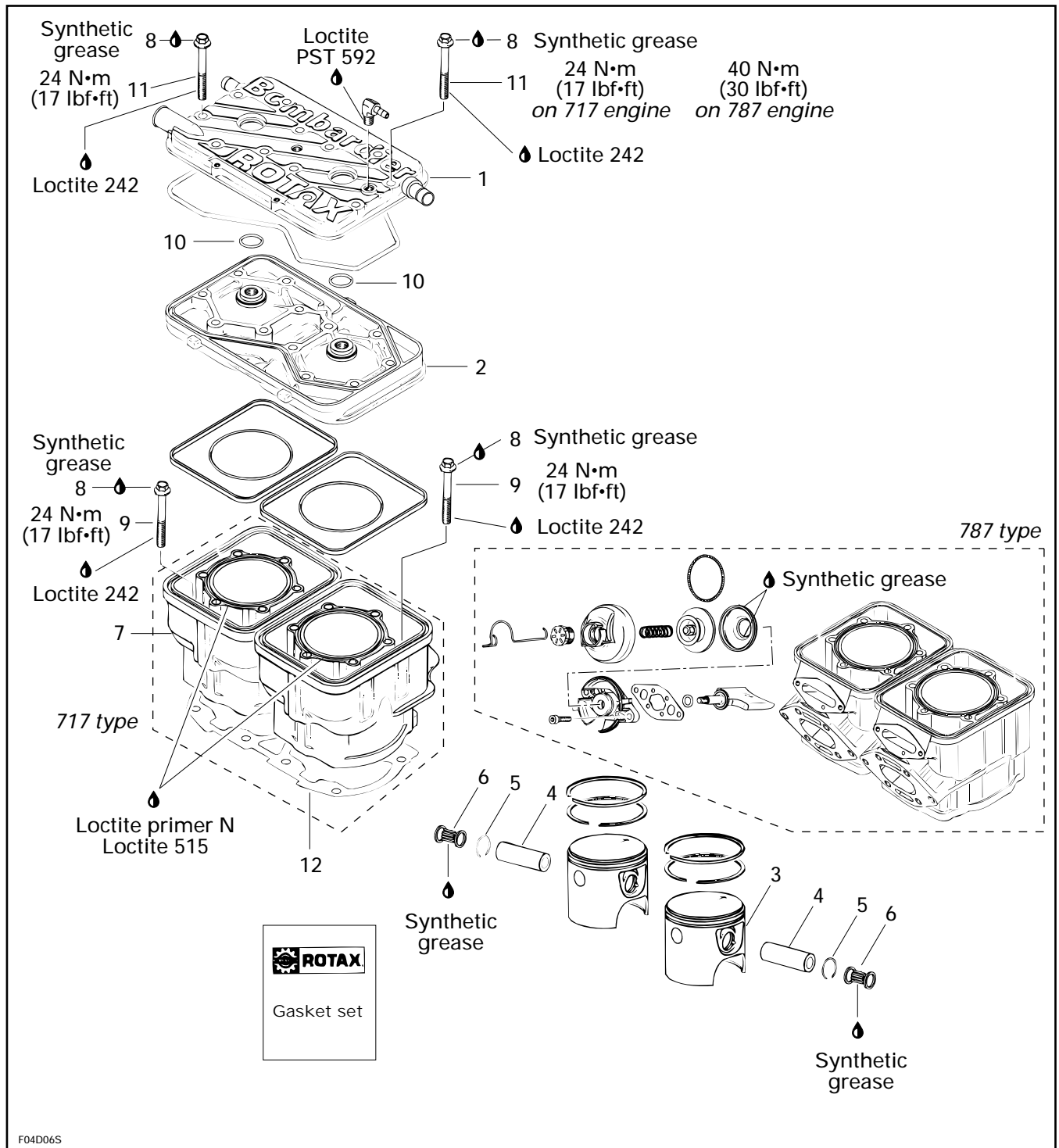
Check throttle cable condition and lubricate cable with BOMBARDIER LUBE lubricant. After its installation, properly adjust and bleed oil injection pump as specified in LUBRICATION SYSTEM, 07-02.

Pressure test fuel system, refer to FUEL SYSTEM 06-03 and look for **Fuel System Pressurization**. Verify all connections and hoses condition.

Run engine(s) and ensure there is no leakage.

 CAUTION : Water must be supplied to cool engine(s) with a garden hose.

TOP END



ENGINE DESCRIPTION

The 2-stroke ROTAX engine rotates counterclockwise seen from the rear (PTO flywheel). It has a rotary valve to control fuel mixture intake. Lubrication is provided by a variable oil injection pump. It is cooled by water supplied from the jet pump. It has a NIPPONDENSO Capacitor Discharge Ignition System. The fuel is provided by diaphragm MIKUNI carburetor having an integrated fuel pump.

▼ **CAUTION** : No engine components can be interchanged between engines.

GENERAL

When repairing a seized engine, connecting rods should be checked for straightness and crankshaft for deflection / misalignment. Refer to BOT-TOM END for procedures.

DISASSEMBLY

In order to repair engine top end proceed as follows:

Electrical Connections

Refer to ENGINE REMOVAL AND INSTALLATION 04-01, then look for **Electrical Connections**.

Exhaust System

To withdraw tuned pipe, refer to ENGINE REMOVAL AND INSTALLATION 04-01, then look for **Tuned Pipe Removal**.

Intake System

To remove air intake silencer, refer to ENGINE REMOVAL AND INSTALLATION 04-01, then look for **Air Intake Silencer Removal**.

1,2, Cylinder Head Cover and Cylinder Head

Remove cylinder head cover.

If shells, sand, salt or any other particles are present in cylinder head, clean with a vacuum cleaner.

Remove cylinder head.

If shells, sand, salt water or any other particles are present in cylinder cooling jacket, clean with a vacuum cleaner.

Remove cylinders, being careful that connecting rods do not hit crankcase edge.

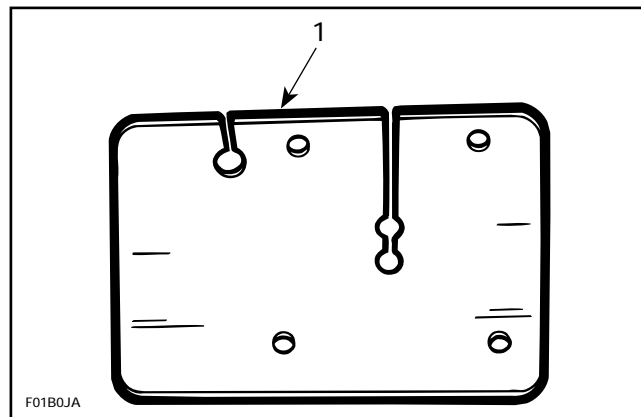
◆ **WARNING** : If screws need to be heated for removal when engine is in jet boat, fuel system pressurization must be done first. Do not use open flame; use a heat gun. An explosion might occur since vapors can be present in engine compartment.

○ **NOTE** : Even if only 1 cylinder needs repair, both cylinders should be lifted to allow 1-piece cylinder base gasket replacement.

3,4,5,6, Piston, Piston Pin, Circlip and Roller Bearing

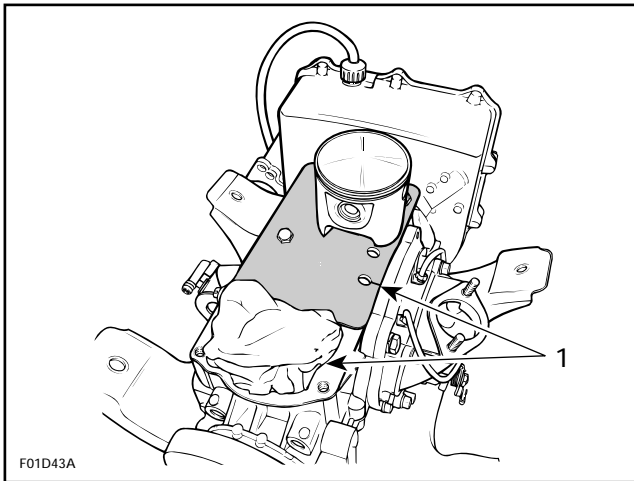
○ **NOTE** : These engines feature cageless piston pin bearing.

Bring piston to Top Dead Center and install rubber pad (P / N 295 000 101) over crankcase opening. Secure with screws. Lower piston until it sits on pad.



1. Rubber pad

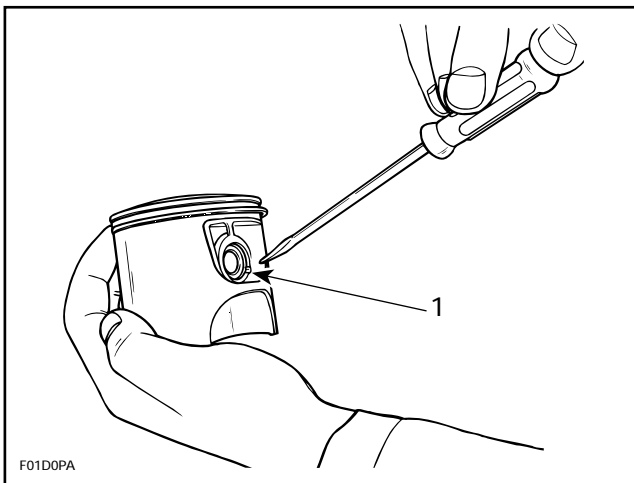
If other cylinder has been removed, completely cover its opening with a clean rag.



1. Openings covered with rag and rubber pad

To remove circlip, insert a pointed tool in piston notch then pry it out and discard.

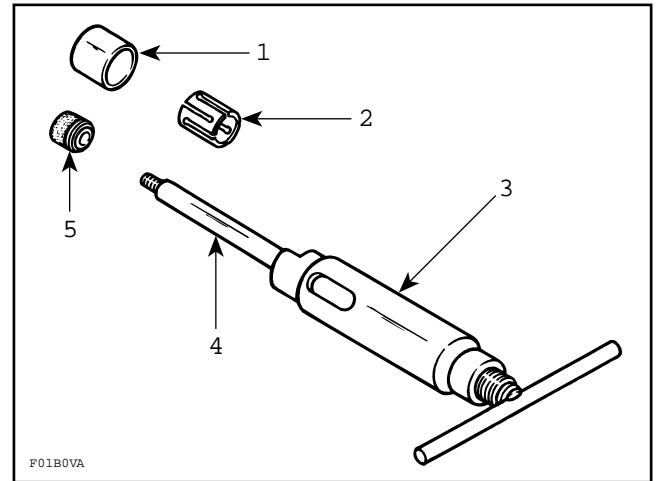
◆ **WARNING :** Always wear safety glasses when removing piston circlips.



1. Piston notch

To extract piston pin, use piston pin puller (P / N 295 000 092) as follows:

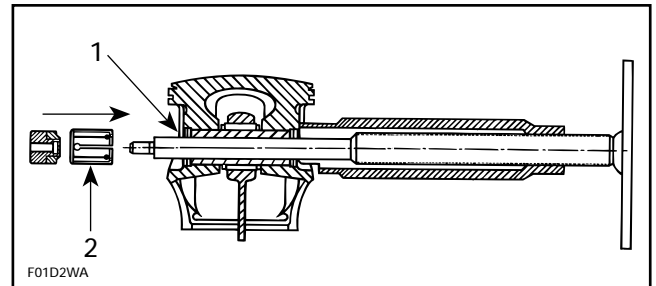
- Fully thread on puller handle.
- Insert extractor spindle into the piston pin.
- Slide the expansion sleeve (P / N 290 877 041) onto the spindle.
- Screw in extracting nut (P / N 290 877 155) with the movable extracting ring towards spindle.



PISTON PIN PULLER (P/N 290 000 105)

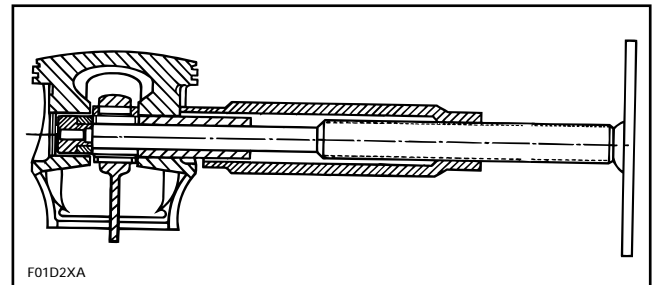
1. Locating sleeve (P / N 290 877 181)
2. Expansion sleeve (P / N 290 877 041)
3. Extractor sleeve
4. Extractor spindle
5. Extracting nut (P / N 290 877 155)

- Firmly hold puller and rotate handle to pull piston pin.

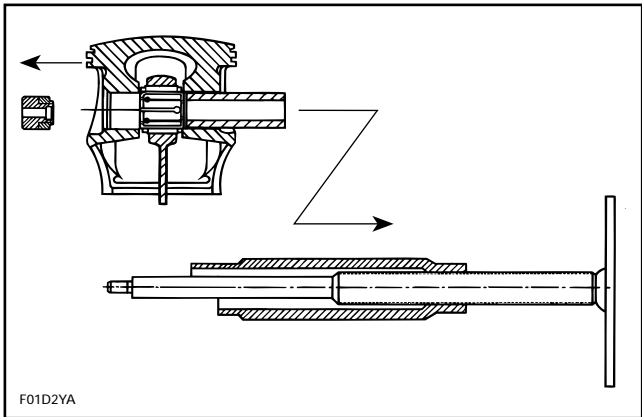


1. Circlip at this side not to be removed
2. Grease expansion sleeve

- By turning the spindle, pull out piston pin until it is completely removed from bearing.



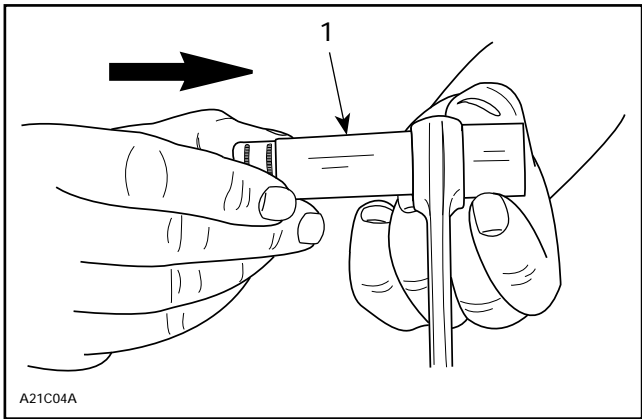
- Rotate spindle until extracting nut can be removed.
- Remove spindle and extractor sleeve from piston pin.
- Carefully remove the piston.



– The needles, thrust washers and the expansion sleeve remain in the connecting rod bore and may be used again.

To remove rollers with the thrust washers from the connecting rod bore, push them together with the expansion sleeve into the locating sleeve (P / N 290 877 180) using any suitable 23 mm (.905 in) diameter pusher.

CAUTION : Recover rollers, make sure that 34 rollers are found for each piston.



1. Pusher 23 mm (.905 in)

CLEANING

- Discard all gaskets and O-rings.
- Clean all metal components in a solvent.
- Clean water passages and make sure they are not clogged.
- Remove carbon deposits from cylinder exhaust port, cylinder head and piston dome.
- Clean piston ring grooves with a groove cleaner tool, or a piece of broken ring.

INSPECTION

Visually inspect all parts for corrosion damage.

Inspect piston for damage. Light scratches can be sanded with a fine sand paper.

Inspect plane surfaces for warpage. Small deformation can be corrected by grinding surface with a fine sand paper. Install sand paper on a surface plate and rub part against oiled sand paper.

The inspection of engine top end should include the following measurements.

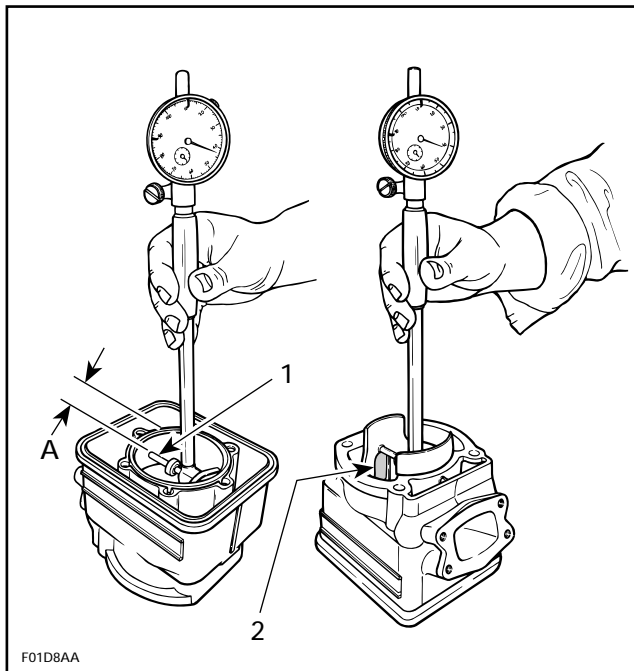
ENGINE MEASUREMENT	TOLERANCES (ALL ENGINES)		
	NEW PARTS (min.)	(max.)	WEAR LIMIT
Cylinder Taper	N.A.	N.A.	0.1 mm (.004 in)
Cylinder Out of Round	N.A.	N.A.	0.08 mm (.003 in)
Piston / Cylinder Clearance for 717 Engine	0.06 mm (.0024 in)	0.08 mm (.0031 in)	0.2 mm (.008 in)
Piston / Cylinder Clearance for 787 Engine	0.10 mm (.0024 in)	0.06 mm (.0024 in)	0.06 mm (.0024 in)
Ring / Piston Groove Clearance	0.06 mm (.0039 in)	0.12 mm (.0047 in)	0.15 mm (.006 in)
Ring End Gap	0.25 mm (.010 in)	0.06 mm (.016 in)	0.06 mm (.039 in)

NOTE : Replacement cylinder sleeves are available if necessary. Consult a specialized shop for installation.

NOTE : 0.25 annd rings available if necessary.

Cylinder Taper

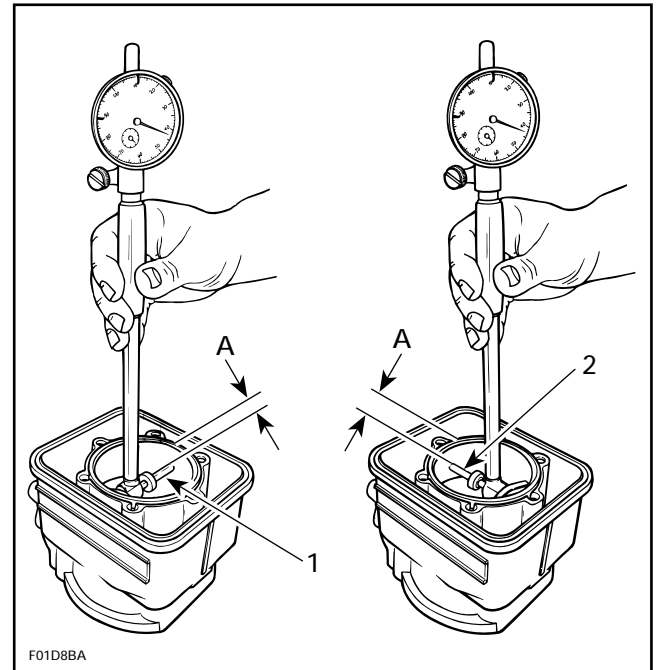
Using a cylinder bore gauge, measure cylinder diameter 16 mm (5/8 in) from top of cylinder to just below auxiliary transfer port, facing exhaust port. If the difference between readings exceed specification, cylinder should be rebored and honed or replaced.



1. Measuring perpendicularly (90 °) to piston pin axis
2. Auxiliary transfer port
- A. 16 mm (5/8 in)

Cylinder Out of Round

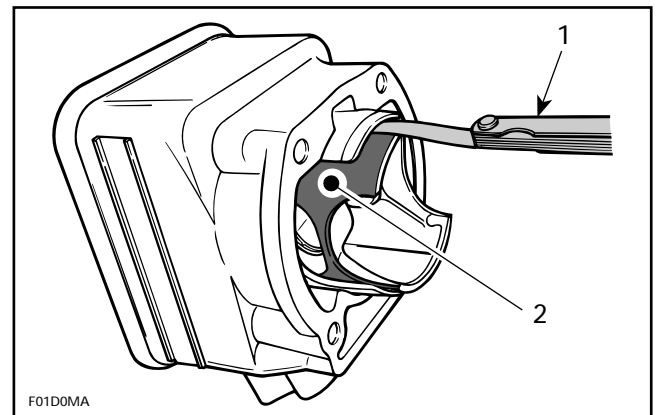
Using a cylinder bore gauge, measure cylinder diameter 16 mm (5/8 in) from top of cylinder. Measure diameter in piston pin axis direction then perpendicularly (90°) to it. If the difference between readings exceed specification, cylinder should be rebored and honed or replaced.



1. Measuring in piston pin axis
2. Measuring perpendicularly (90 °) to piston pin axis
- A. 16 mm (5/8 in)

Piston / Cylinder Clearance

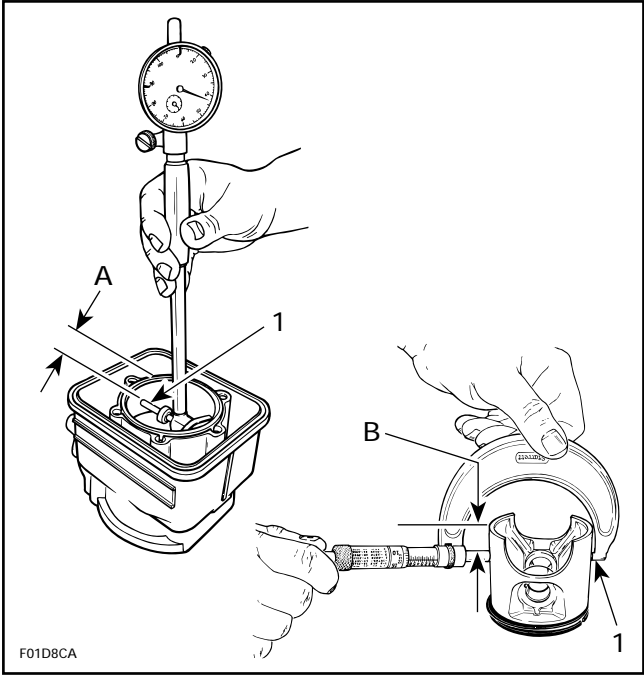
Clearance can be quickly checked with a long feeler gauge. Insert feeler gauge in cylinder then slide piston (without piston rings installed) into cylinder as shown in the following illustration.



1. Feeler gauge
2. Piston

Or, to accurately determine piston to cylinder wall clearance. Measure piston 25 mm (1 in) below skirt end perpendicularly (90°) to piston pin.

Measure cylinder 16 mm (5/8 in) below its top edge.



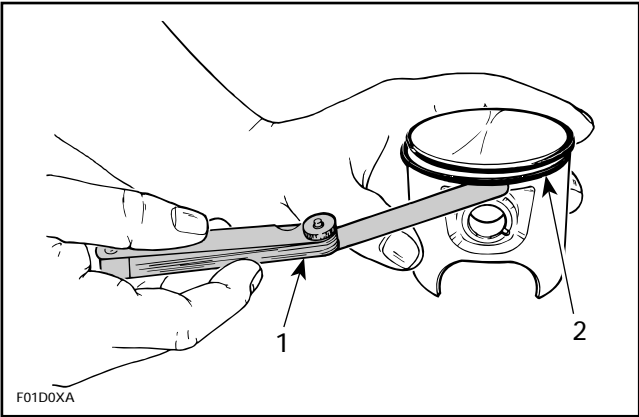
1. Measuring perpendicularly (90 °) to piston pin axis
A. 16 mm (5/8 in)
B. 25 mm (1 in)

The difference between these 2 measurements should be within specified tolerance.

Ring / Piston Groove Clearance

Using a feeler gauge, check clearance between rectangular ring and groove. If clearance exceeds specified tolerance, replace piston.

NOTE : Ring / piston groove clearance can be correctly measured only on rectangular ring which is bottom ring.



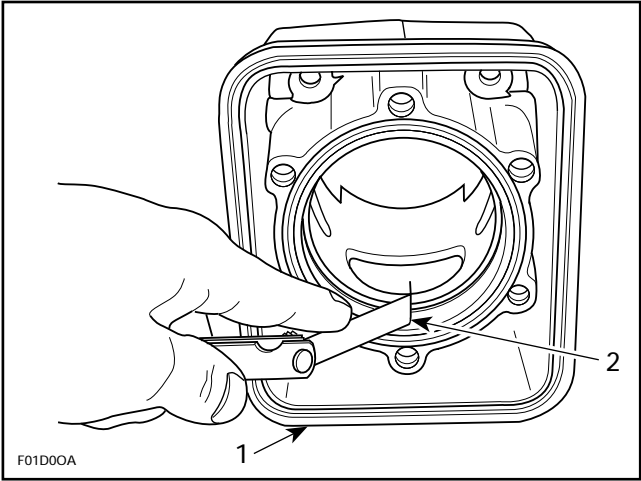
1. Feeler gauge
2. Rectangular ring (bottom)

Ring End Gap

Position ring halfway between exhaust port and top of cylinder.

NOTE : In order to correctly position ring in cylinder, use piston as a pusher.

Using a feeler gauge, check ring end gap. If gap exceeds specified tolerance, rings should be replaced.

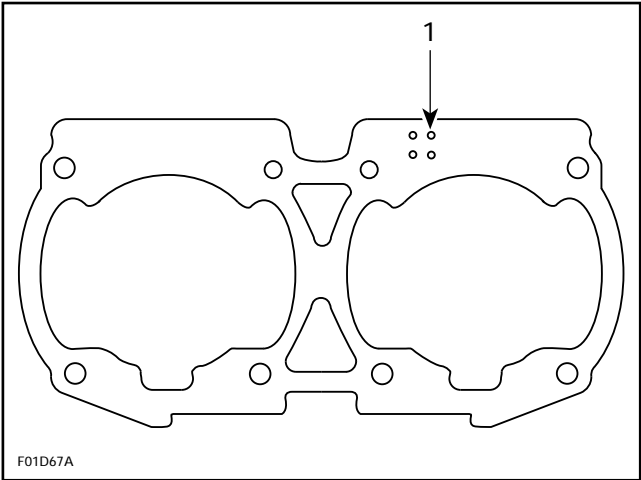


1. Top of cylinder
2. Ring end gap

12, Cylinder Base Gasket

Five thicknesses of cylinder base gaskets are available for a precise adjustment of the squish gap.

To determine gasket thickness, refer to the identification holes on the gasket.



1. Identification holes

GASKET THICKNESS	IDENTIFICATION HOLES
0.3 mm (0.012 in)	3
0.4 mm (0.016 in)	4
0.5 mm (0.020 in)	5
0.6 mm (0.024 in)	6
0.8 mm (0.031 in)	8

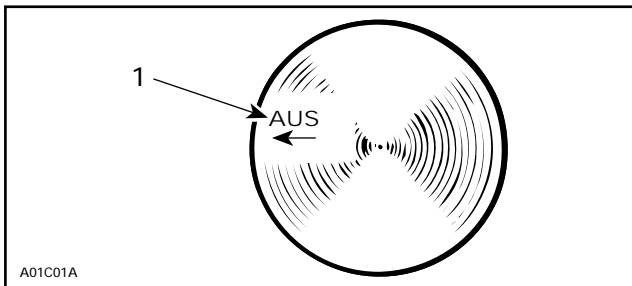
NOTE : Squish gap measurement is discussed further in this sub-section.

ASSEMBLY

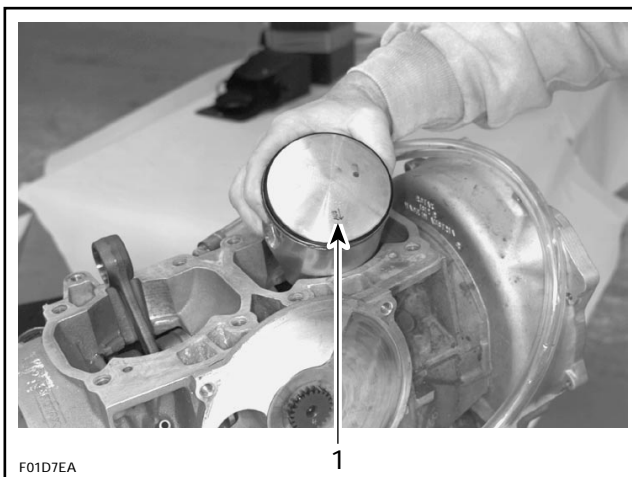
Assembly is essentially the reverse of disassembly procedures. However pay particular attention to the following.

3, Piston

At assembly, place the pistons over the connecting rods with the letters "AUS" (over an arrow on the piston dome) facing in direction of the exhaust port. On the 787, it is the same side as the intake.



1. Exhaust side



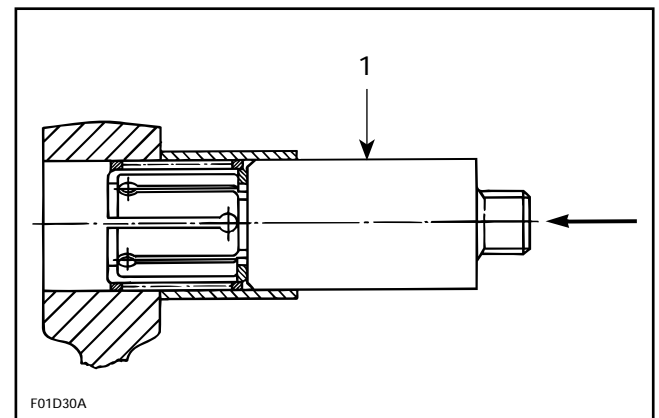
787 ENGINE SHOWN
1. "AUS"

Carefully cover crankcase opening as for disassembly.

4,6, Piston Pin and Roller Bearing

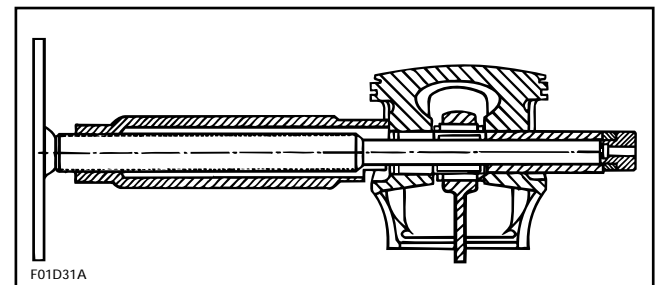
To install roller bearing and piston pin use piston pin puller (P / N 290 877 092), proceed as follows:

- Replacement bearings are held in place by a locating sleeve outside and 2 plastic cage halves inside.
- Push needle bearing together with inner halves out of the locating sleeve into the connecting rod bore.
- Use any suitable 23 mm (.905 in) diameter pusher as a tool. Make sure thrust washers are present each side of needles.



1. Pusher

- Insert piston pin into piston until it comes flush with inward edge of piston hub.
- Warm piston to approximately 50-60°C (122-140°F) and install it over connecting rod.
- Insert extractor spindle into the piston pin, screw on extracting nut.
- Rotate handle to pull piston pin carefully into the piston.



Section 04 ENGINE

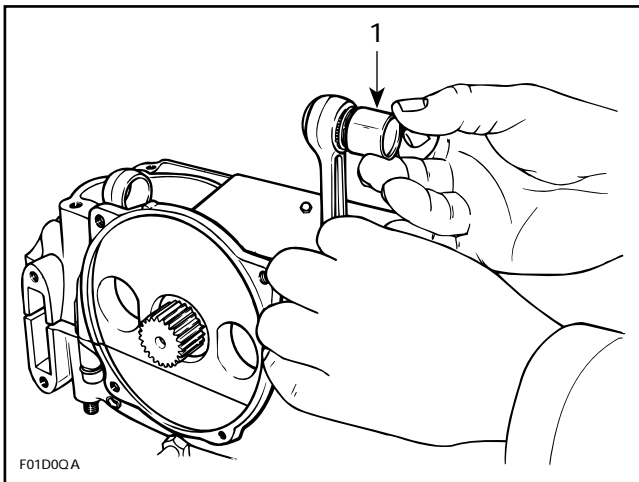
Sub-Section 02 (TOP END)

PLASTIC MOUNTING DEVICE METHOD

As an alternate method when no service tool is available proceed as follows:

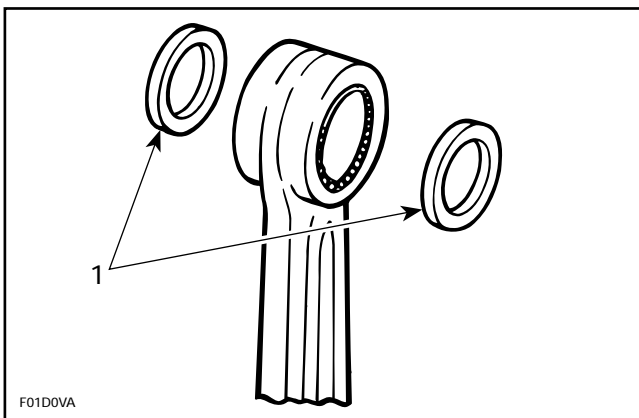
Replacement roller bearings are delivered in a convenient plastic mounting device. For installation, proceed as follows:

- Align replacement roller bearing with connecting rod bore.
- Carefully push inner plastic sleeve into connecting rod bore; outer plastic ring will release rollers.



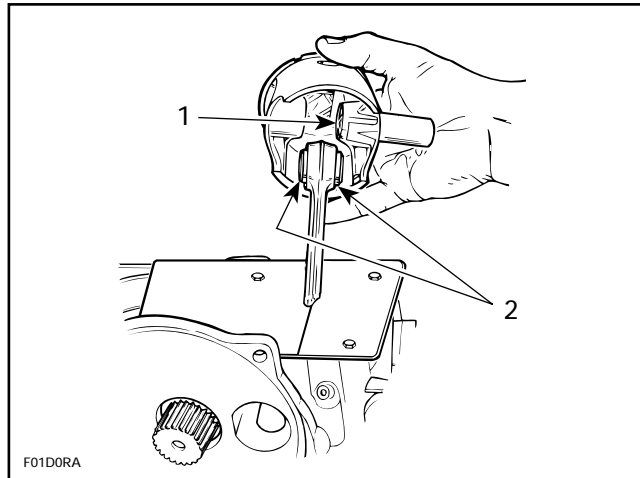
1. Outer ring removal after inner sleeve insertion into bore

- Make sure thrust washers are present each side of rollers.



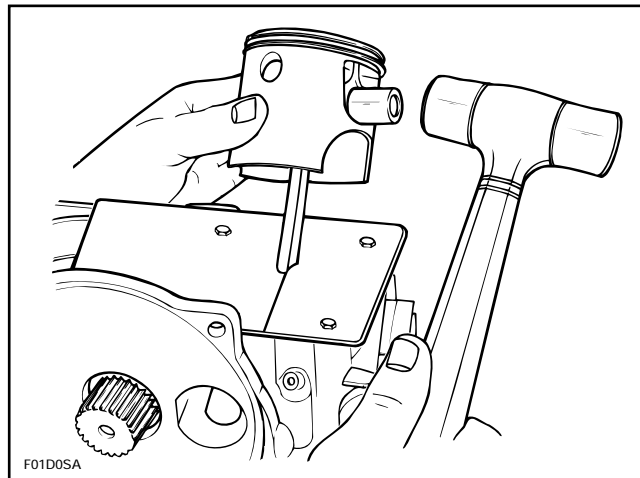
1. Thrust washer each side.

- Insert piston pin into piston until it comes flush with inward edge of piston hub.

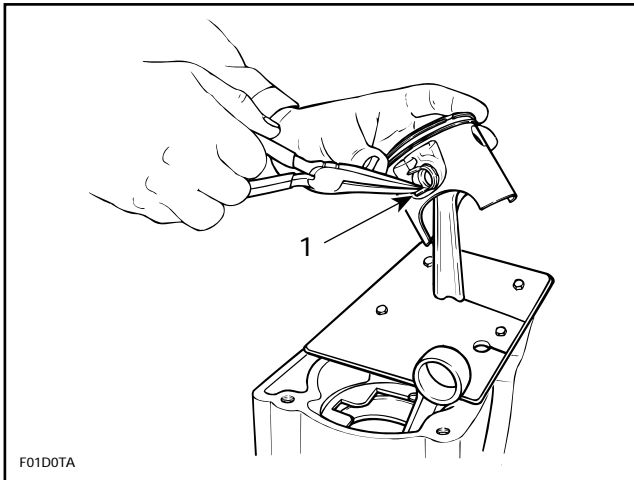


1. Piston pin flush here
2. Thrust washers

- Place piston over connecting rod and align bores, then gently tap piston pin with a fiber hammer to push out inner plastic ring on opposite side. Support piston from opposite side.



- As necessary, pull halves of inner sleeve with long nose pliers.

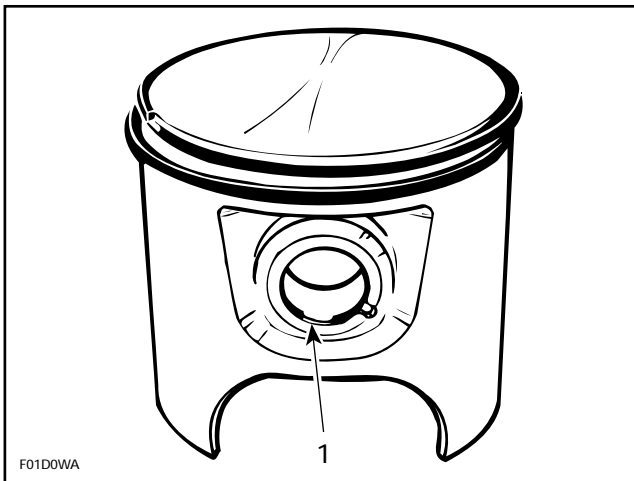


1. Pulling inner sleeve half

5, Circlip

Secure remaining circlip taking into consideration the following.

▼ **CAUTION** : To minimize the stress on the circlips, install them so that their openings are located at 6 o'clock (at bottom).

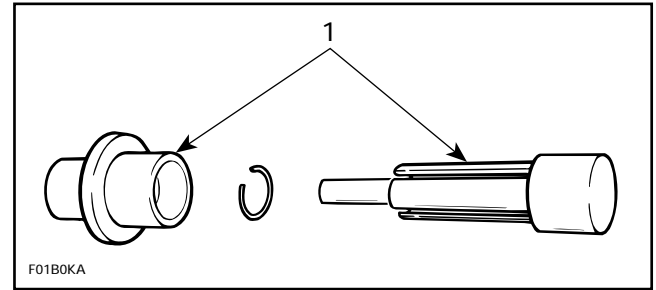


1. Circlip opening at 6 o'clock (at bottom)

◆ **WARNING** : Always wear safety glasses when installing piston circlips.

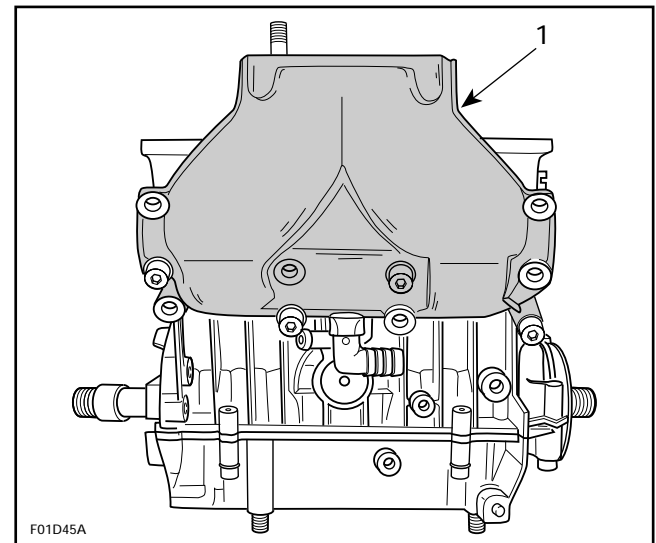
▼ **CAUTION** : Always use new circlips. At installation, take care not to deform them. Overstressed circlips will come loose and will damage engine. Circlips must not move freely after installation, replace if circlip rotates after installation.

To easily insert circlip into piston, use circlip installer (P / N 290 877 016).



1. Circlip installer

- Remove pusher from tool then insert circlip into its bore.
- Reinstall pusher into tool and push until circlip comes in end of tool.
- Position end of tool against piston pin opening.
- Firmly hold piston against tool and push tool pusher to insert circlip into its groove.



717 ENGINE SHOWN

1. Aligning cylinders using exhaust manifold

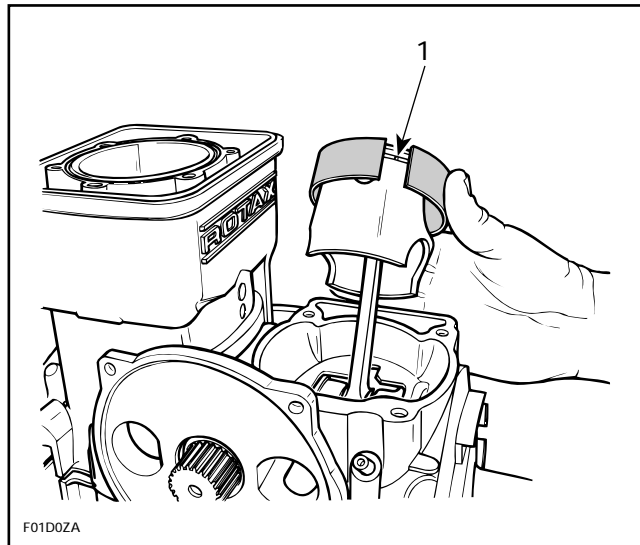
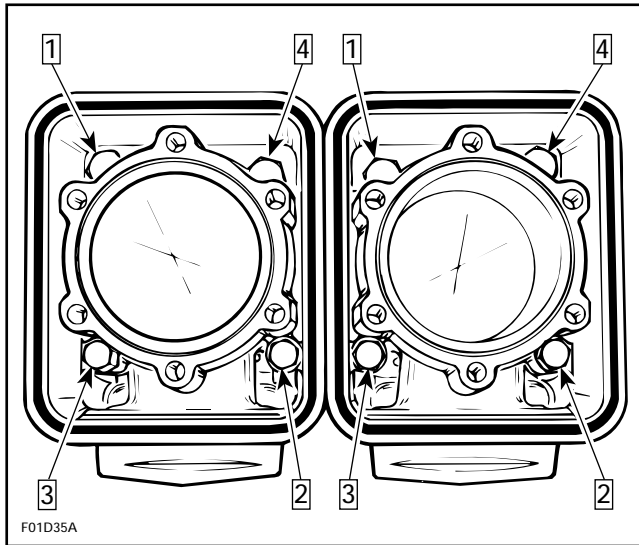
7,8,9, Screw, Grease and Cylinder

717 Engine Type

Apply synthetic grease (Pp/pN 293 550 010) below screw head. Apply Loctite 242 (blue) on screw threads. Install and torque screws in a criss-cross sequence for each cylinder to 24 N•m (17 lbf•ft).

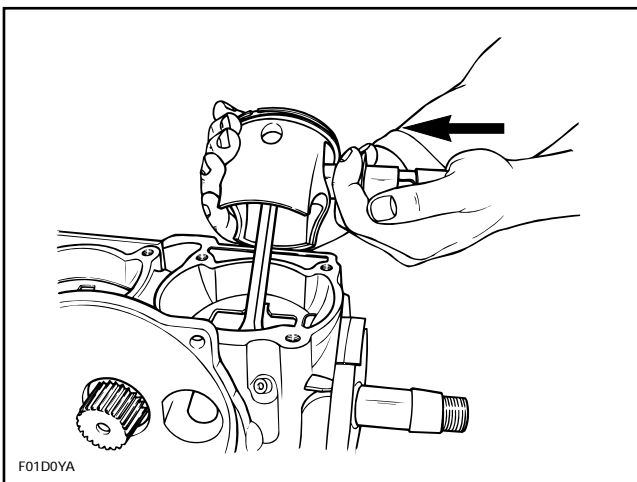
Section 04 ENGINE

Sub-Section 02 (TOP END)



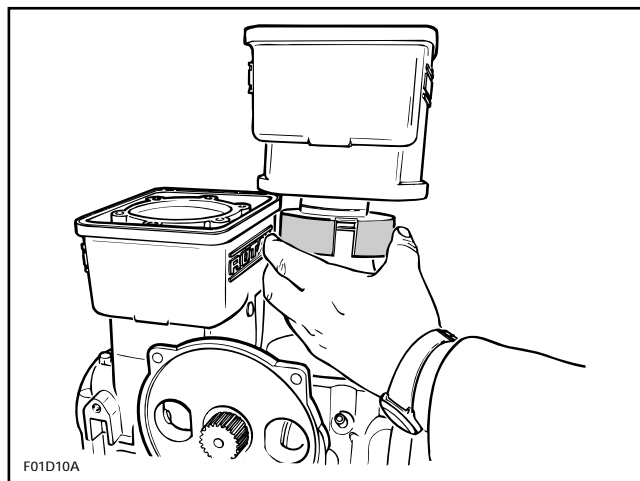
1. Ring end gap aligned with piston locating pin

Install cylinder gasket and slide cylinder over piston.

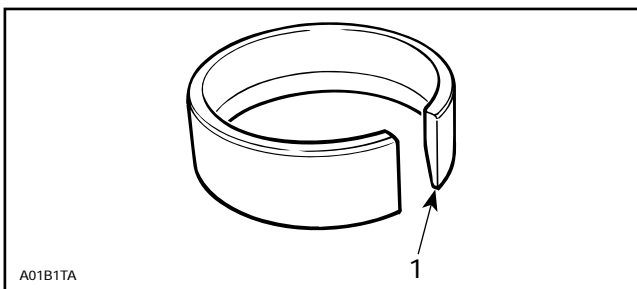


7, Cylinder

To easily slide cylinder over piston, install ring compressor (P / N 295 000 112) over rings.



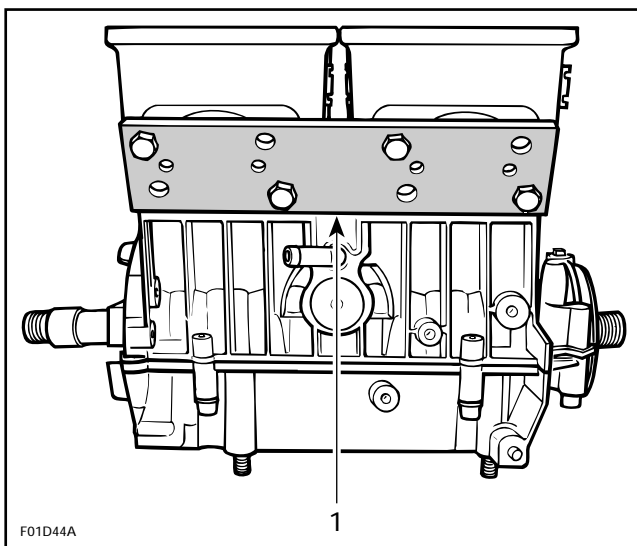
When reassembling cylinders to crankcase, it is important to have them properly aligned so that exhaust flanges properly match up with exhaust manifold. Use aligning tool (P / N 290 876 902) or exhaust manifold itself.



1. Slide this edge

NOTE : Ring compressor will not fit on over-size piston / rings.

Make sure to align ring end gap with piston locating pin. Slide tool over rings.



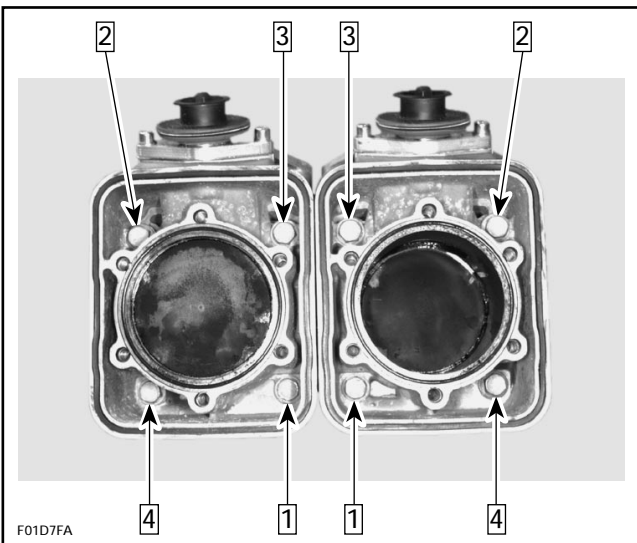
717 ENGINE SHOWN

1. Exhaust flange aligning tool

787 Engine Type

Install M10 x 100 screws on exhaust side and the M10 x 73.5 on opposite side.

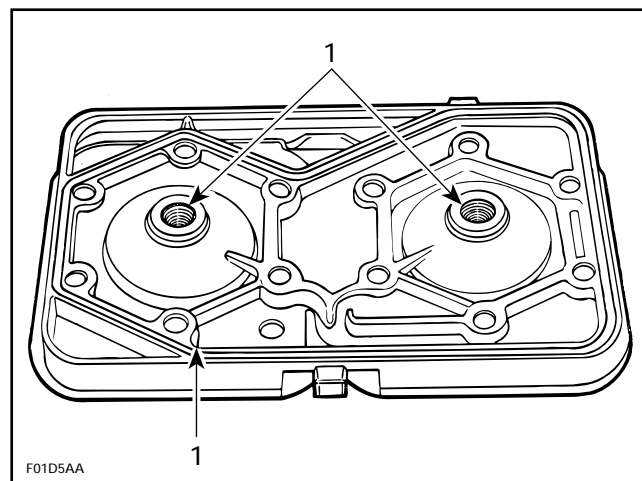
Torque screws in a criss-cross sequence for each cylinder to 20 N•m (15 lbf•ft). Repeat the procedure, re-tightening all cylinder screws to 40 N•m (30 lbf•ft).



2,10, Cylinder Head and O-ring

Apply Loctite 515 Gasket Eliminator (P / N 293 800 007) in cylinder sleeve O-ring groove.

Make sure to install O-rings around spark plug holes and cylinder head O-ring where shown.



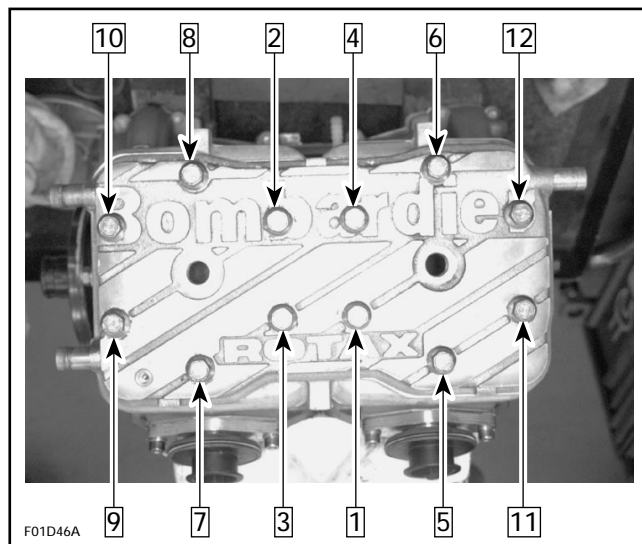
1. O-ring

1,11, Cylinder Head Cover and Screw

Apply synthetic grease (P / N 293 550 010) below screw head.

Install cover over cylinder head. Apply Loctite 242 (blue) on screw threads.

Torque cylinder head screws to 24 N•m (17 lbf•ft) as per following illustrated sequence.



RAVE SYSTEM

Theory

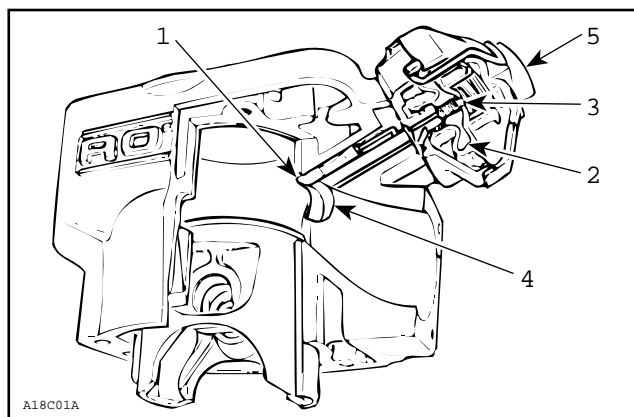
For a 2-stroke-cycle engine to have high power capacity at high crankshaft speeds, a high volumetric or breathing efficiency is required and the fresh charge losses must be minimized. The result is achieved by opening the exhaust port early and utilizing the resonant effects of the tuned exhaust system to control fresh charge losses.

When an engine of this design is run at a medium speed, efficiency falls off quickly. The relatively high exhaust port effectively shortens the useful power stroke and because the exhaust system is tuned for maximum power, there is a large increase of fresh charge losses. As a result, the torque decreases along with a dramatic increase of the specific fuel consumption. Higher torque along with lower fuel consumption can be obtained at lower engine speeds if the time the exhaust port is open is shortened.

Bombardier-Rotax has patented a remarkably simple system to automatically change the exhaust port height based on pressure in the exhaust system.

Located above the exhaust port is a guillotine-type slide valve. This rectangular valve is connected by a shaft to a diaphragm which is working against the return spring. Two small passages in the cylinder just outside the exhaust port allow exhaust gas pressure to reach the diaphragm.

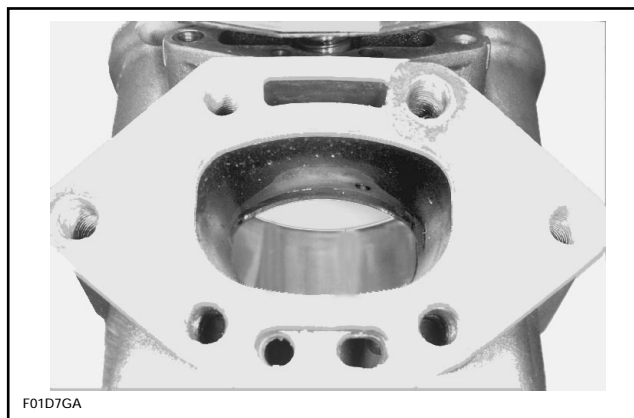
To the outside of the return spring is a red plastic adjustment knob. Turning the adjustment in or out changes the preload on the return spring which, in turn, will change the RPM at which the RAVE valve opens and closes.



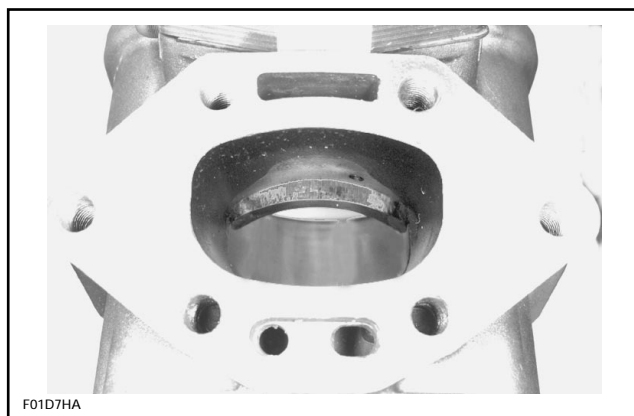
TYPICAL

1. Sliding valve
2. Diaphragm
3. Spring
4. Exhaust port
5. Adjustment knob

As the throttle is opened and the engine begins producing more power, the pressure against the diaphragm will overcome the pressure of the return spring and the RAVE valve will open.



VALVE FULLY OPENED



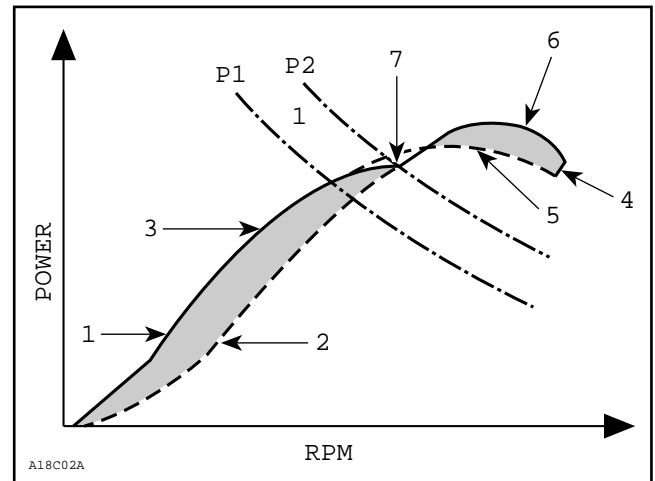
VALVE FULLY CLOSED

The RAVE valve does not allow an engine to make higher peak horsepower than an engine not so equipped, it can make moving the peak higher practical because of its effect on the rest of the power curve. Item 2 in the following figure is the power curve of an engine with the RAVE valve held fully open through its entire RPM range. Item 6 notes the peak power produced. That peak will not change if the exhaust port time of a similar engine without a RAVE valve was the same (with all other features equal).

Item 1 is the power curve of the engine with the RAVE valve closed through its entire RPM range. The shaded area (item 3) is the improvement in power at lower engine speeds that is gained because of the lower exhaust port. If the port remains at this height, however, the power would peak as noted in item 5. Raising the exhaust port at the proper RPM (item 7) will allow the engine peak power to continue to rise (item 6).

Item P1 in figure is the pressure of the return spring against the diaphragm. The exhaust pressure must be high enough to overcome this pressure before the valve begins opening. Item P2 is the pressure required to completely open the RAVE valve. Between P1 and P2, the useable power curve of the engine is moving from power curve 1 to power curve 2. This transition takes place very rapidly at full throttle and from a practical standpoint can be considered to be instantaneous at item 7. Gradual application of the throttle, however, will result in the RAVE valve opening much later.

If the RAVE valve opens too late, the engine will bog or hesitate momentarily as the RPM increases. Full peak performance (item 6) is still available. From a functional point of view. It is better to have the valve open a bit early than a bit late.



Maintenance

There are no wear parts anywhere in the system and there are no adjustments to be periodically checked. The only possible maintenance required would be cleaning of carbon deposits from the guillotine slide. Cleaning intervals would depend upon the user's riding style and the quality of the oil used. Using FORMULA XP-S synthetic injection oil, we would suggest annual cleaning of the valve. If a customer uses a lower quality oil, more frequent cleaning may be required.

No special solvents or cleaners are required when cleaning the valve.

Boring Precaution

In its stock configuration the RAVE valve guillotine has a minimum of 0.5 mm (.020 in) clearance to the cylinder bore measured at the center line of the cylinder. This is the minimum production clearance.

There is only a first oversize piston available for the 787 engine. That piston is 0.25 mm (.010 in) larger in diameter than the stock piston. When the oversize is installed, the guillotine will have a minimum clearance of 0.375 mm (.015 in) with the cylinder bore. This is the minimum operating clearance the guillotine should be used with. Clearance less than 0.375 mm (.015 in) will require reworking of the guillotine to achieve the proper clearance and radius.

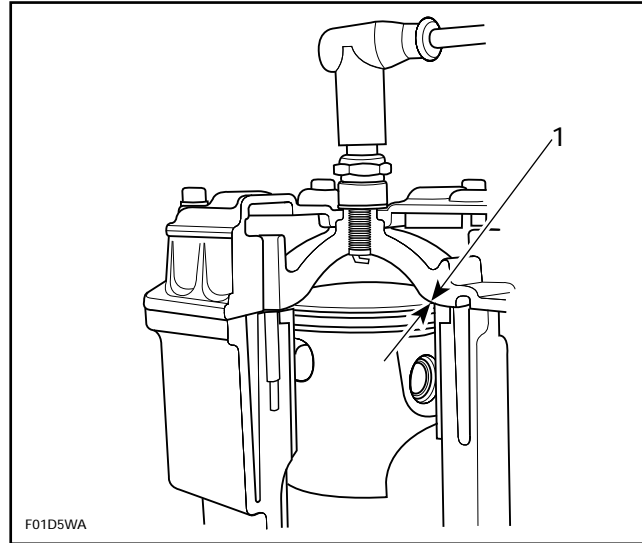
Troubleshooting

SYMPTOM	CAUSE	REMEDY
Engine revs 500 to 1000 RPM lower than its maximum operational RPM ; RAVE valve does not open at all.	1. Bend valve rod	Replace
	2. Stuck valve	Clean
	3. Wrong spring tension (too high)	Replace
	4. Clogged passages	Clean
	5. Damaged diaphragm	Replace
Engine hesitation. Peak performance is delayed until higher RPM range is reached. RAVE valve opens too early.	1. Broken or weak spring	Replace
	2. Adjustment screw too far out	Turn until it bottoms
	3. Valve stuck open	Clean

SQUISH AREA

Rotax rotary valve engines incorporate a combustion chamber which feature a squish area. This area is basically a "ledge" projecting beyond combustion chamber area. In operation, as the piston ascends and approaches the ledge, a rapid squeezing action is applied to the air / fuel mixture contained in the area immediately between the piston dome and the ledge. This squishing action forces the entrapped mixture rapidly into the combustion chamber area, creating a greater mixture turbulence. Additionally, the small volume and large surface area of the squish band allow a better cooling of the end gases to help prevent detonation.

▼ **CAUTION :** When reassembling an engine, always measure squish gap to make sure it is within the specified tolerance.



1. Squish gap

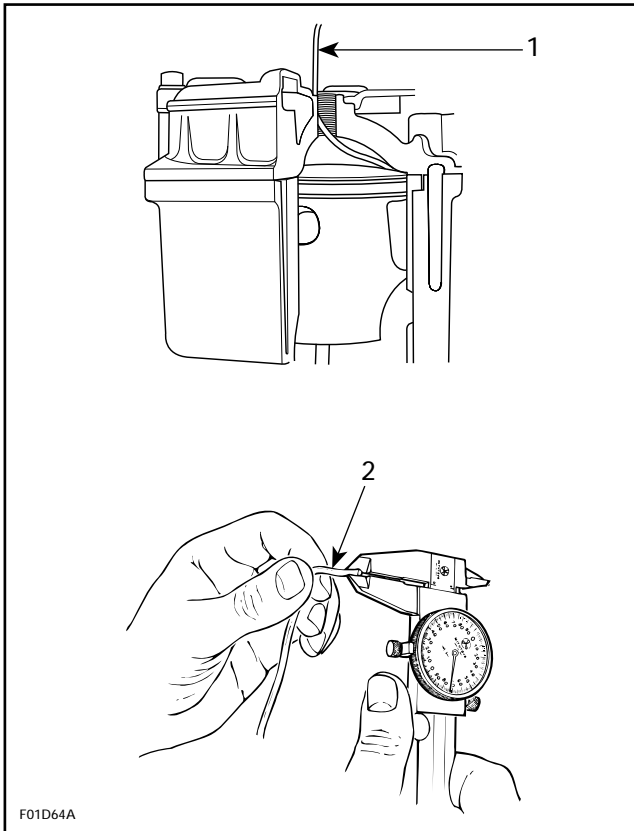
If the squish gap is increased, a loss in power will occur, while too small a squish gap will lead to detonation.

Squish Gap Measurement

The squish gap can be measured by inserting a piece of resin core solder into the combustion chamber.

- Insert solder in combustion chamber.
- Rotate the engine through Top Dead Center ; remove the solder and measure the thickness of the compressed solder.

○ **NOTE :** The solder should be inserted above and in line with the wrist pin.



1. Solder
2. Measure here

CAUTION : Do not use acid core solder ; the acid can damage the piston and cylinder.

- Take another measurement at the opposite side of the piston.
- Repeat procedure for the other cylinder.

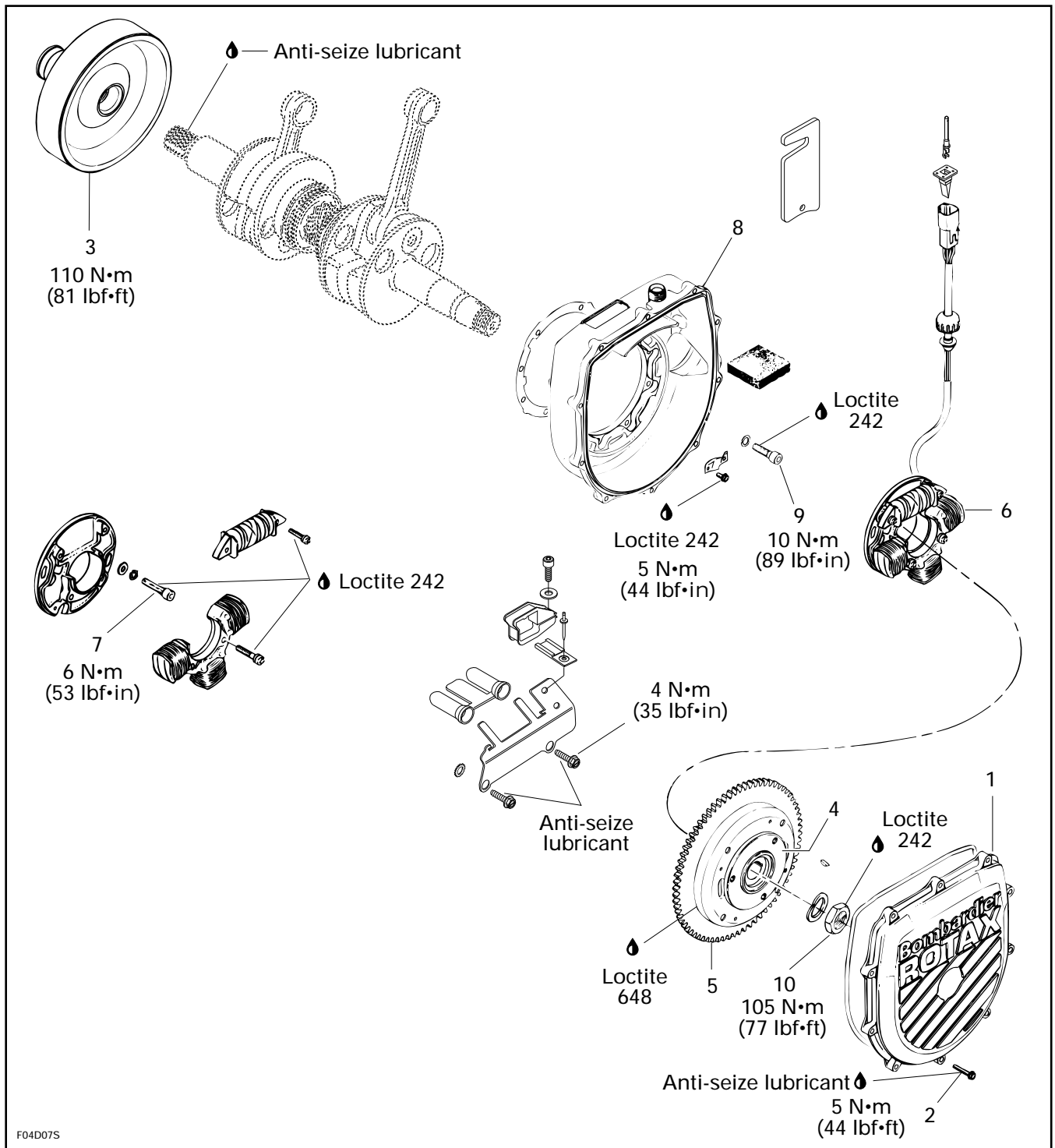
The lowest and the highest values of both cylinders must be within the specified range.

ENGINE	SQUISH GAP
717	1.3 - 1.7 mm (.051 - .067 in)
787	1.2 - 1.6 mm (.047 - .063 in)

If adjustment is required, replace cylinder base gasket accordingly, using a thicker or thinner cylinder base gasket.

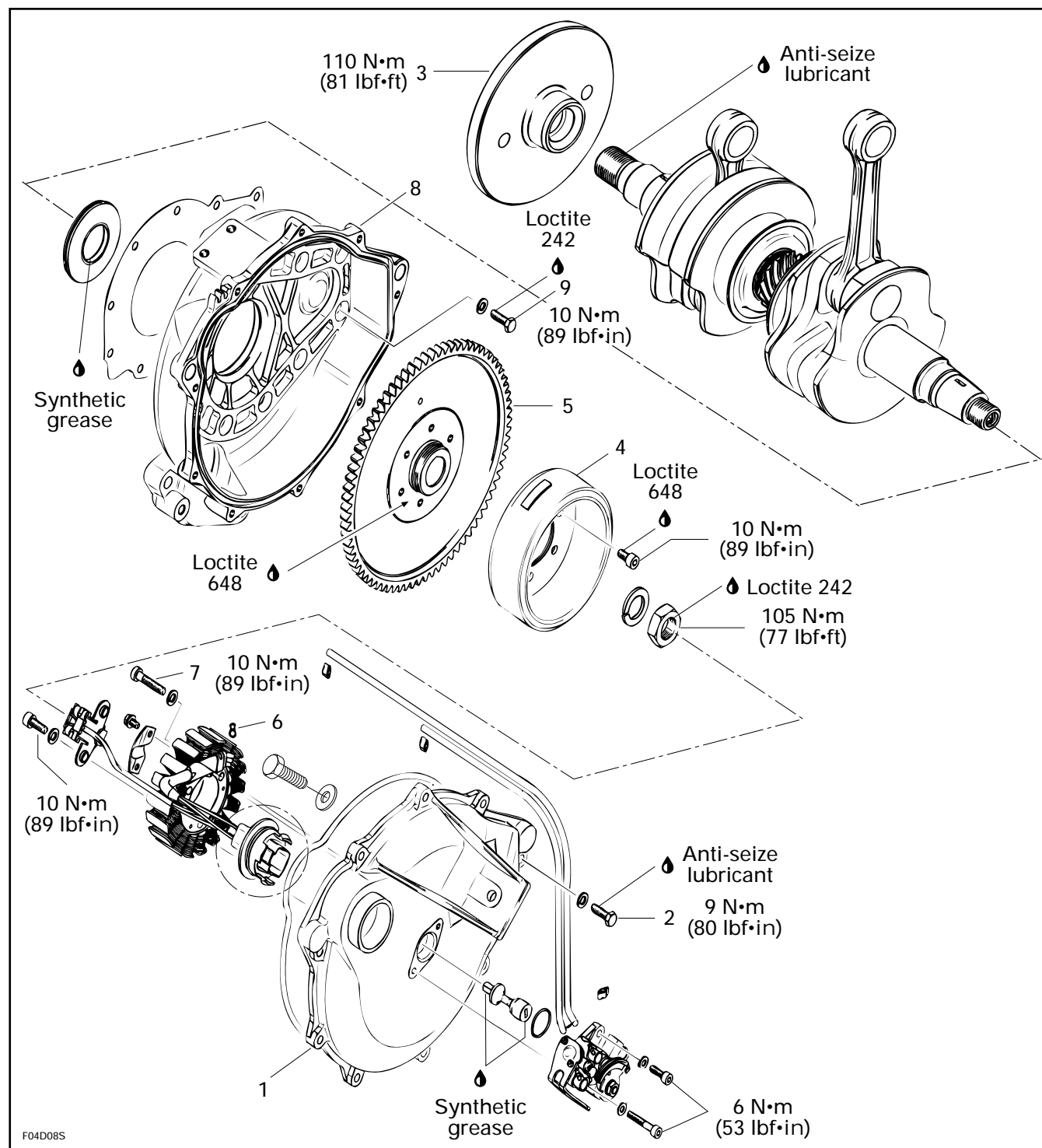
PTO FLYWHEEL AND MAGNETO

717 Engine



Section 04 ENGINE
Sub-Section 03 (PTO FLYWHEEL AND MAGNETO)

787 Engine



F04D08S

GENERAL

The following procedures can be performed without removing engine from jet boat. For only PTO flywheel removal withdraw jet pump unit ass'y, refer to PROPULSION AND DRIVE SYSTEMS 09-01 then refer to **Jet Pump Removal**.

To ease the removal of PTO flywheel heat center of flywheel with a heat gun to break bond. Always pressurize fuel system first.

◆ **WARNING** : Never use a torch in the engine compartment. Electrolyte or fuel vapors can be present and may ignite.

REMOVAL

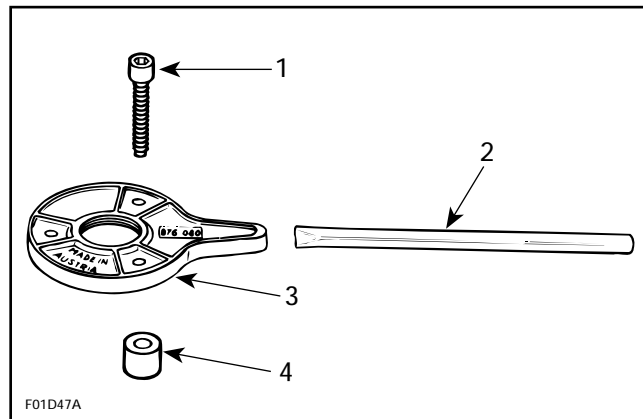
1,2, Ignition Cover and Screw

Remove screws, wire support and spark plug grounding device (if applicable) then withdraw cover.

○ **NOTE** : PTO side flywheel must be removed prior removing MAG side flywheel since puller has to be installed on MAG flywheel.

717 Engine

For removal of both flywheels, MAG flywheel is locked with puller plate (P / N 290 876 080), sleeves (P / N 290 847 220) and extension handle (P / N 295 000 111).



1. Screw
2. Extension handle
3. Puller plate
4. Sleeve

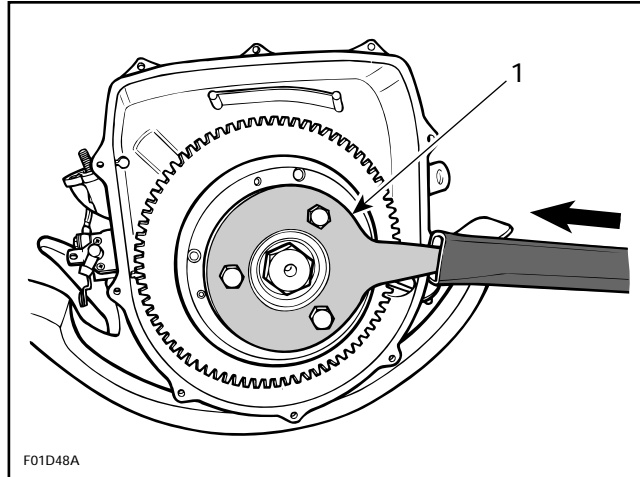
▼ **CAUTION** : Never lock crankshaft by inserting any tool through connecting rod bores nor through impulse fitting.

3, PTO Flywheel

717 Engine

Using 3 M8 x 35 screws (P / N 290 841 591), install screws through puller plate and slide sleeves on screws then secure puller plate on MAG flywheel so that sleeves are against flywheel.

Install extension handle on end of puller plate.

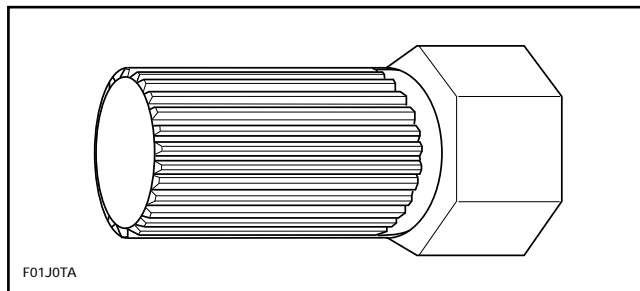


TYPICAL

1. Sleeves on opposite side

Rotate MAG flywheel so that extension handle end can be held easily before PTO flywheel loosening.

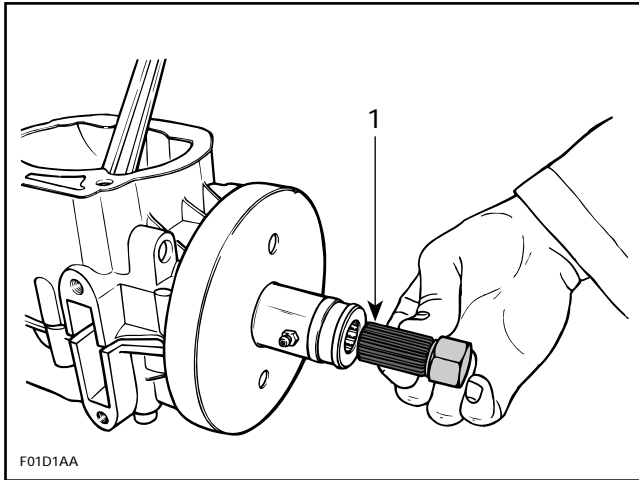
PTO flywheel is loosen using PTO flywheel remover (P / N 295 000 001).



Insert special tool in PTO flywheel splines.

Section 04 ENGINE

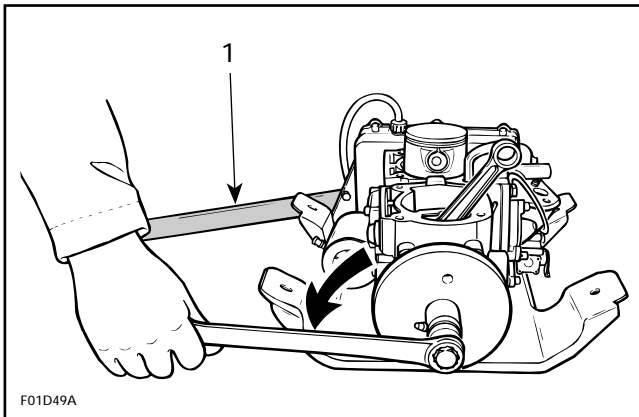
Sub-Section 03 (PTO FLYWHEEL AND MAGNETO)



TYPICAL

1. PTO flywheel remover (P / N 295 000 001)

Using a suitable wrench or socket, unscrew PTO flywheel COUNTERCLOCKWISE when facing it.

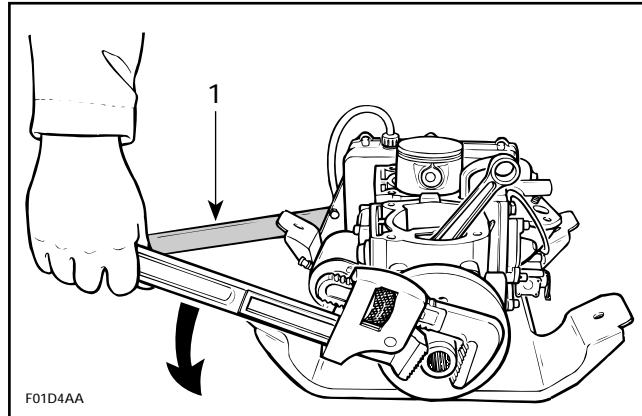


TYPICAL

1. Extension handle locking crankshaft

As an alternate method to remove PTO flywheel when PTO flywheel splines are worn out and PTO flywheel remover cannot be used.

Use a pipe wrench and install it on PTO flywheel as illustrated.



TYPICAL

1. Extension handle locking crankshaft

787 Engine

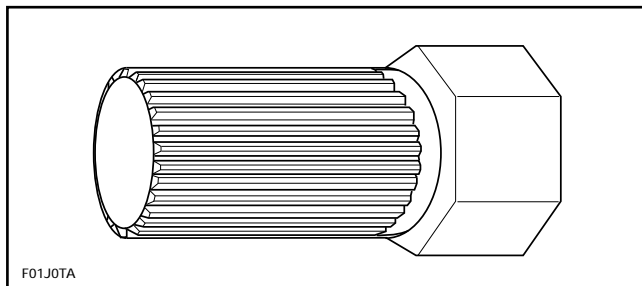
Remove starter.

Lock ring gear using special tool (Pp/pN 295 000 134).

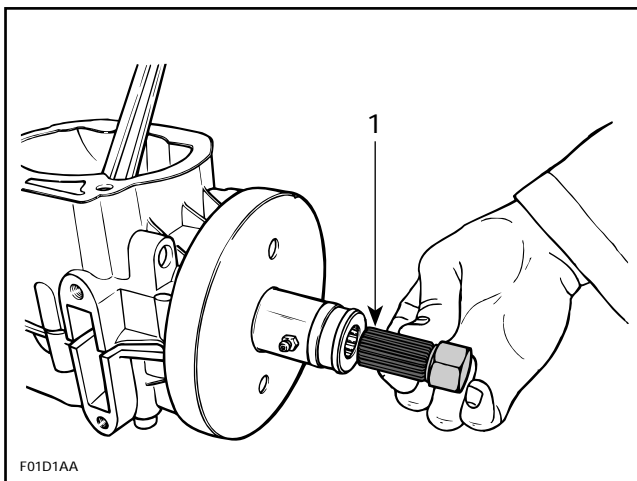
1. Tool

Install PTO flywheel locking tool (Pp/pN 295 000 001) in flywheel splines.

Using a suitable socket, unscrew PTO flywheel COUNTERCLOCKWISE when facing it.



Insert special tool in PTO flywheel splines.



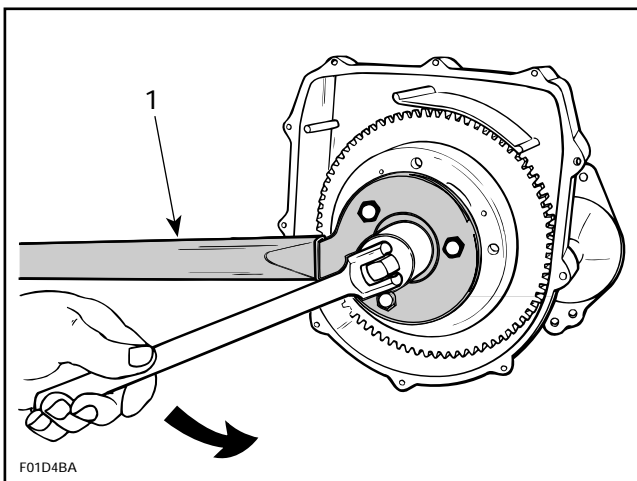
TYPICAL

1. PTO flywheel remover (P / N 295 000 001)

4, Magneto Flywheel

717 Engine

With puller plate properly secured as for PTO flywheel removal, rotate MAG flywheel so that extension handle end can be held easily before loosening.



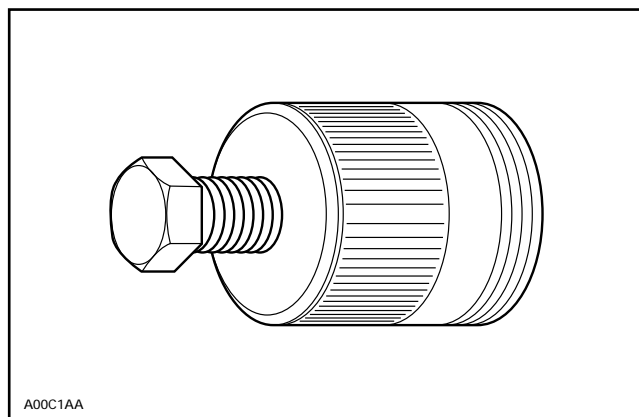
TYPICAL

1. Extension handle locking crankshaft

Using a suitable socket, unscrew retaining nut COUNTERCLOCKWISE when facing it.

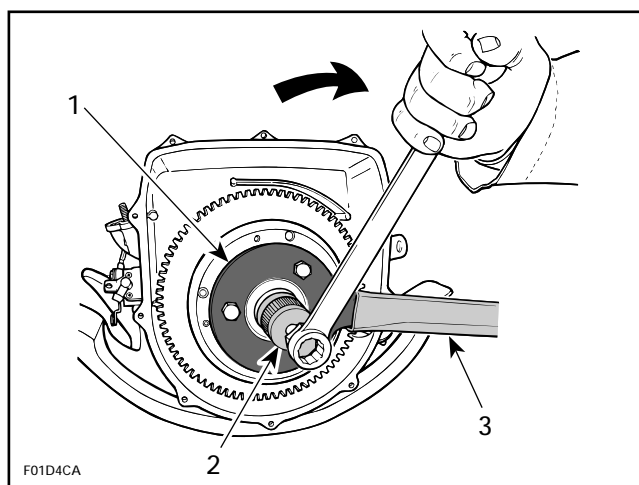
NOTE : If socket is found too large to be inserted in puller plate, machine or grind its outside diameter as necessary.

Remove nut and lock washer from MAG flywheel. MAG flywheel is easily freed from crankshaft with puller (P / N 295 000 106).



Fully thread on puller in puller plate.

Tighten puller bolt and at the same time, tap on bolt head using a hammer to release MAG flywheel from its taper.



1. Puller plate
2. Puller
3. Extension handle

Magneto Rotor and Engine Flywheel Removal

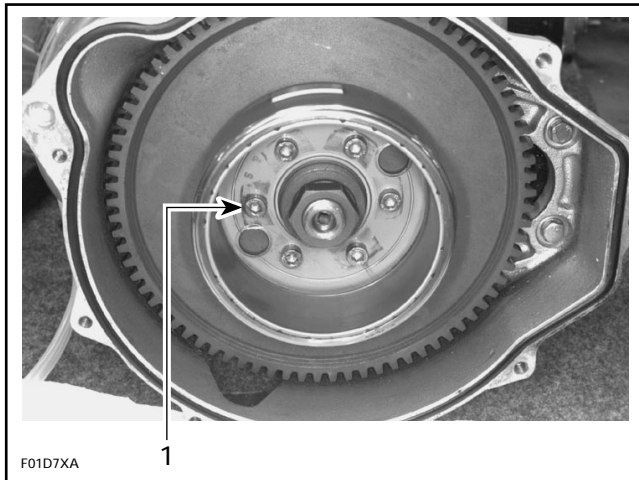
787 Engine

If desired, magneto rotor can be removed without the engine flywheel. Remove the 6 screws.

NOTE : Make sure ring gear is locked with the PTO flywheel locking tool.

Section 04 ENGINE

Sub-Section 03 (PTO FLYWHEEL AND MAGNETO)



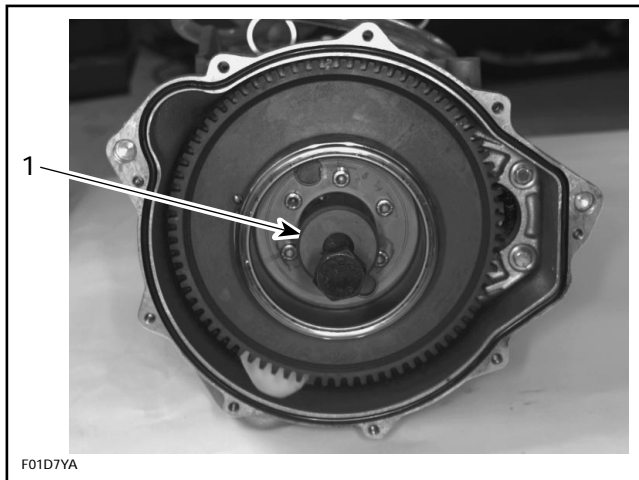
1. Screw

Using a suitable socket, unscrew retaining nut of engine flywheel COUNTERCLOCKWISE when facing it.

Remove special tool locking ring gear.

Engine flywheel is easily freed from crankshaft with puller (P / N 420 976 235) and crankshaft protective cap (P / N 290 876 557).

Insert crankshaft protector to outer end of crankshaft and fully thread puller in engine flywheel.



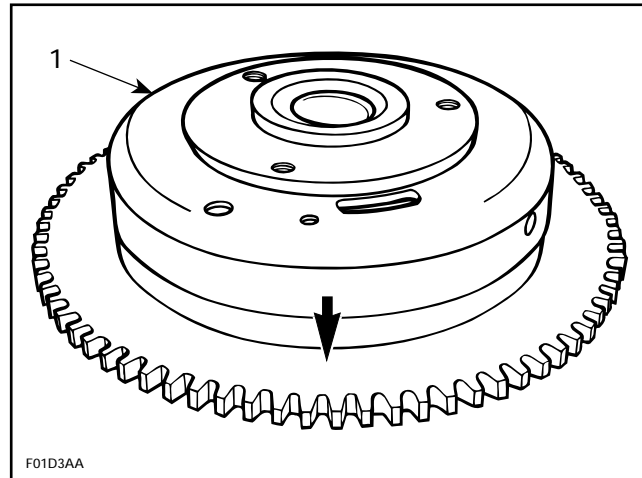
1. Puller

Tighten puller screw and at the same time, tap on screw head using a hammer to release engine flywheel from its taper.

4,5, MAG Flywheel and Ring Gear

717 Engine

Lay MAG flywheel on a steel plate, then to ease removal heat ring gear with a propane torch to approximately 150 °C (300 °F) to break the Loctite bond. Tap lightly on ring gear using a hammer to release it from MAG flywheel.



1. Magneto flywheel

6,7, Screw and Armature Plate Ass'y

717 Engine

To ease reassembly and further ignition timing, indexing marks should be made on armature plate and crankcase.

All Engines

Remove 3 retaining screws and withdraw armature plate.

Crankcase Replacement

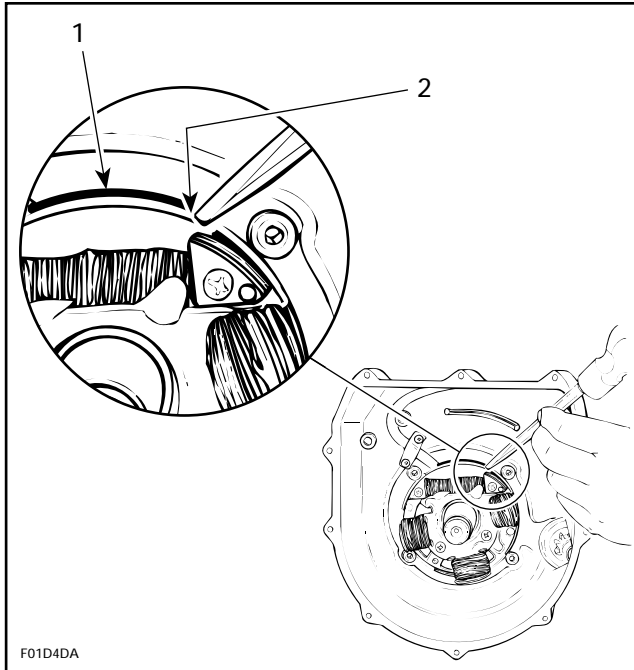
717 Engine

Since replacement crankcases do not have timing mark for armature plate location, indexing marks should be made on armature plate and crankcase to ease reassembly and further ignition timing.

The following procedure is to find a common reference point on both crankcases (old and new) to position armature plate.

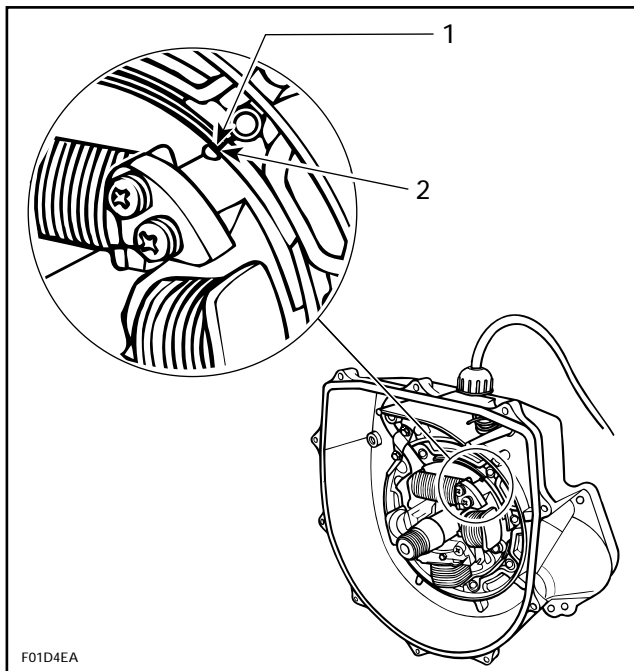
Proceed as follows:

- Find a crankcase locating lug (the top one in this example).
- Place a cold chisel at the end of chosen lug, then punch a mark on armature plate at this point.



1. Crankcase locating lug
2. Mark armature plate at the end of lug

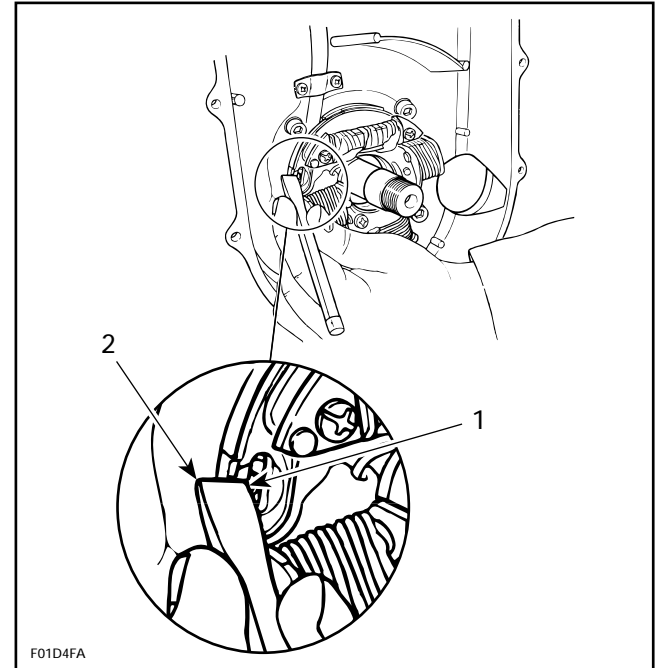
- At assembly, align armature plate mark (previously punched) with the end of the same locating lug on the new crankcase.



TYPICAL

1. Lug end of crankcase
2. Align mark and lug end here

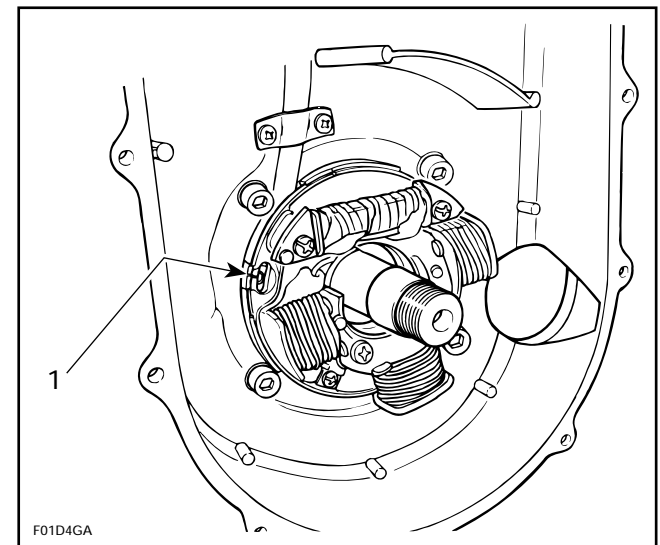
- Find manufacturer's mark on armature plate. In line with this mark, punch another mark on adjacent crankcase lug.



TYPICAL

1. Manufacturer's mark on armature plate
2. Punch a mark on crankcase lug aligned with plate mark

From now on, these marks will be used for further assembly positioning as a pre-timing position.



TYPICAL

1. For further assembly, use these marks

8,9, Ignition Housing and Screw

717 Engine

To remove ignition housing, starter has to be removed. Refer to ELECTRICAL 08-07 under **Starting System** for procedures.

All Engines

Unscrew retaining screws, then withdraw housing.

CLEANING

Clean all metal components in a solvent.

▼ **CAUTION** : Clean armature coils and magneto magnets using only a clean cloth.

Clean crankshaft taper and threads.

INSTALLATION

Installation is essentially the reverse of removal procedures. However pay particular attention to the following.

8,9, Ignition Housing and Screw

On **787 engine**, apply lithium grease on seal lip of ignition housing. To install a new seal, refer to bottom end sub-section.

Install gasket on housing / crankcase mating surfaces.

Apply Loctite 242 (blue) on screw threads then torque them in a criss-cross sequence to 10 N•m (89 lbf•in).

After housing installation, make sure before reinstalling electric starter, that oil outlet fitting is installed on crankcase on **787 engine**, do not install starter yet.

6,7, Screw and Armature Plate Ass'y

Position armature plate on crankcase. Align previously traced marks on both parts (**717 engine**).

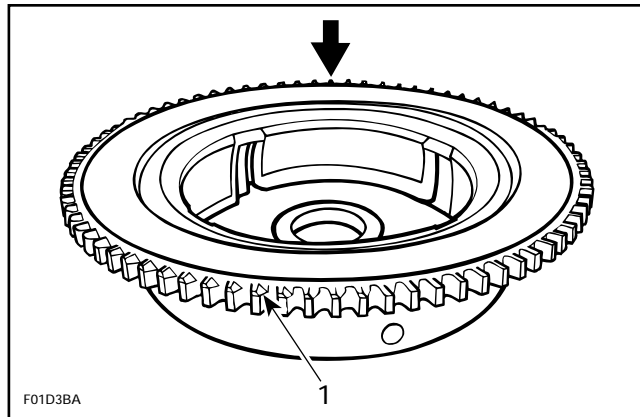
Apply a drop of Loctite 242 (blue) on screw threads and torque to 6 N•m (53 lbf•in) on **717 engine** and 10 N•m (89 lbf•in) on **787 engine**.

4,5, MAG Flywheel and Ring Gear

717 Engine

Apply Loctite 648 (green) to MAG flywheel mating surface. Lay ring gear on a steel plate, then heat with a propane torch in order to install it on MAG flywheel.

Pay particular attention to position ring gear teeth chamfer side as per following illustration.



1. Teeth chamfer

○ **NOTE** : Ensure that ring gear contacts MAG flywheel flange.

Whenever replacing either ring gear or MAG flywheel, Gun Kote must be applied to prevent possible corrosion.

▼ **CAUTION** : Always assemble MAG flywheel and ring gear prior to apply Gun Kote. If not done correctly, ring gear won't contact MAG flywheel flange.

To apply Gun Kote proceed as follows :

1. Clean thoroughly and degrease replacement part using a non oil base solvent.
2. Apply coating in light thin coats using a spray gun.

○ **NOTE** : Do not spray Gun Kote into MAG flywheel threaded holes.

3. Bake parts in oven at 175 °C (350 °F) for 1 hour to cure Gun Kote.

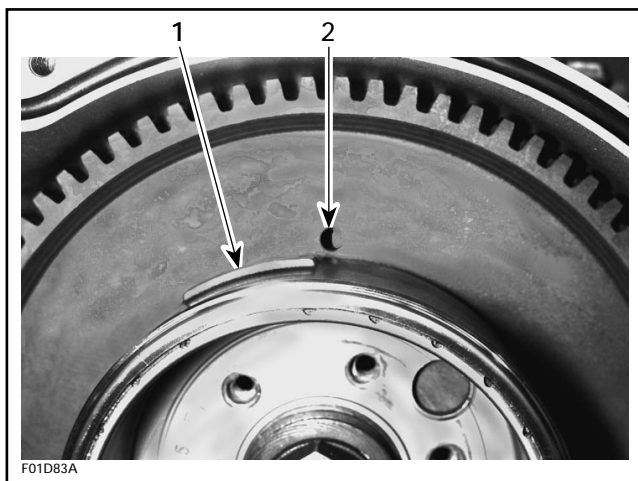
▼ **CAUTION** : Do not eliminate Gun Kote heatcuring time because it will lose all its resistance and it won't give any protection.

▼ **CAUTION** : At installation of magneto, ring gear teeth chamfer and starter clutch should be facing each other.

4,10, Magneto and Nut

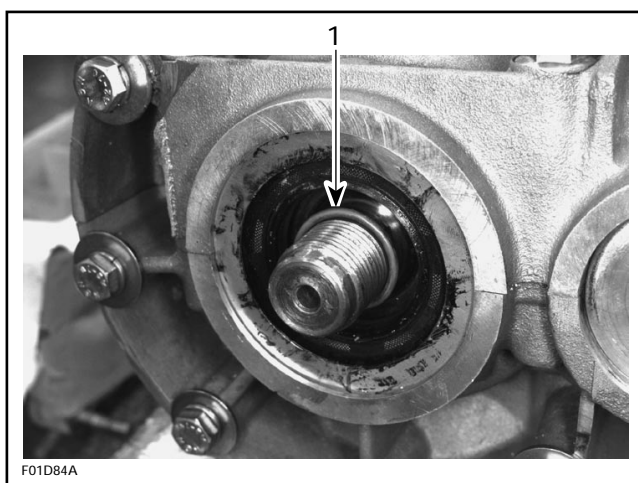
787 Engine

When reinstalling magneto rotor to engine flywheel, one of the protuberance end of magneto rotor must align with hole of engine flywheel.



- 1. Protuberance
- 1. Hole

Prior to installing PTO flywheel, insert O-ring onto crankshaft.



- 1. O-ring

All Engines

Apply Loctite 242 (blue) on crankshaft taper.

Position Woodruff key, magneto, apply Loctite 242 (blue) on nut threads and install fasteners on crankshaft.

Torque nut to 105 N•m (77 lbf•ft).

▼ **CAUTION** : Never use any type of impact wrench at magneto installation.

3, PTO Flywheel

Apply lubricant Anti-Seize on crankshaft threads then screw on PTO flywheel.

Using same tool as for removal, torque PTO flywheel to 110 N•m (81 lbf•ft).

▼ **CAUTION** : Never use any type of impact wrench at PTO flywheel installation.

Ignition Timing

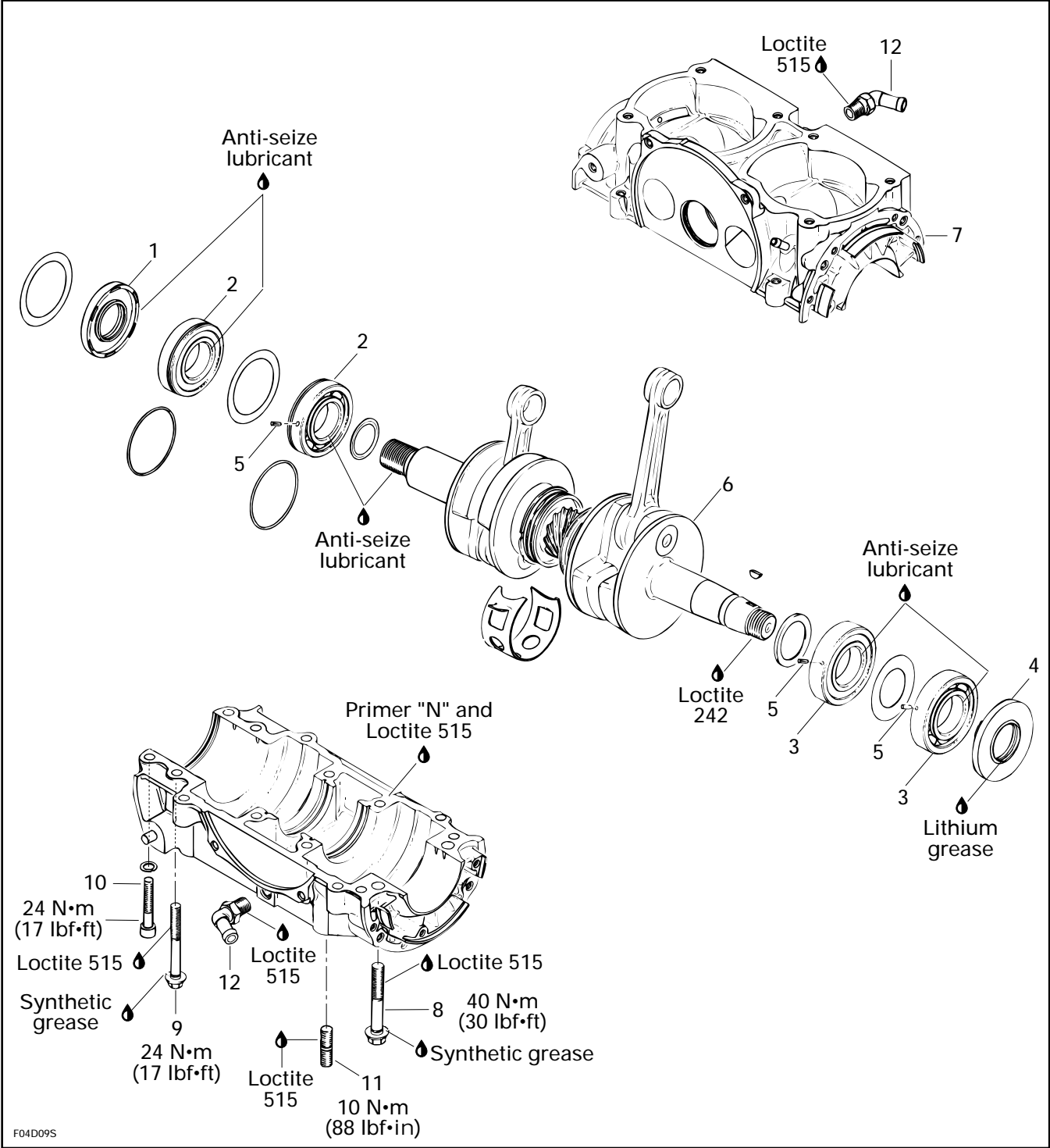
For procedures, refer to ELECTRICAL 08-03 under Ignition System.

1,2, Ignition Housing Cover and Screw

Properly install O-ring in ignition housing. Apply Loctite 767 Anti-Seize on screw threads, install cover, wire support and spark plug grounding device then torque screws in a criss-cross sequence to 5 N•m (44 lbf•in).

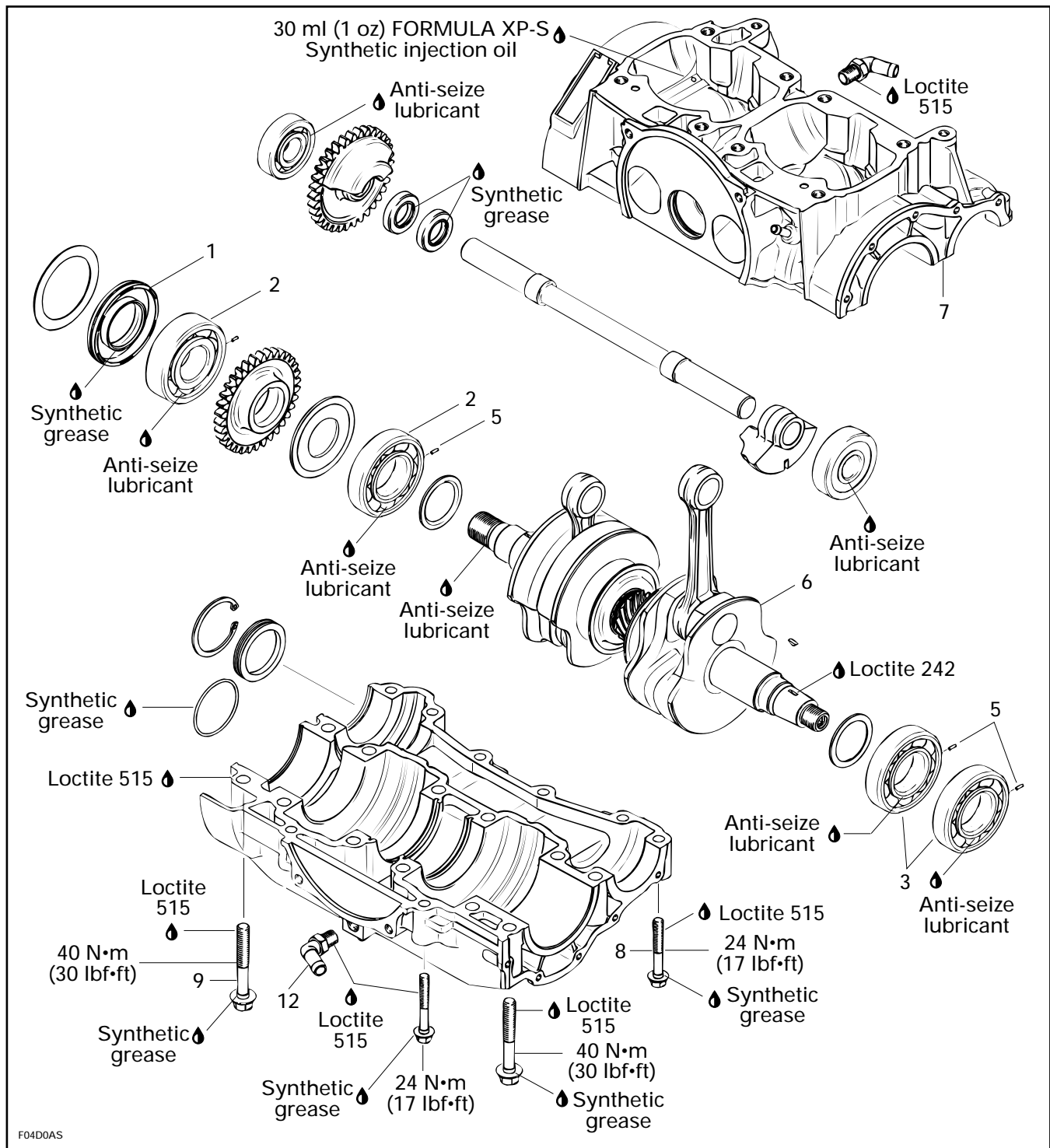
BOTTOM END

717 Engine



Sub-Section 04 (BOTTOM END)

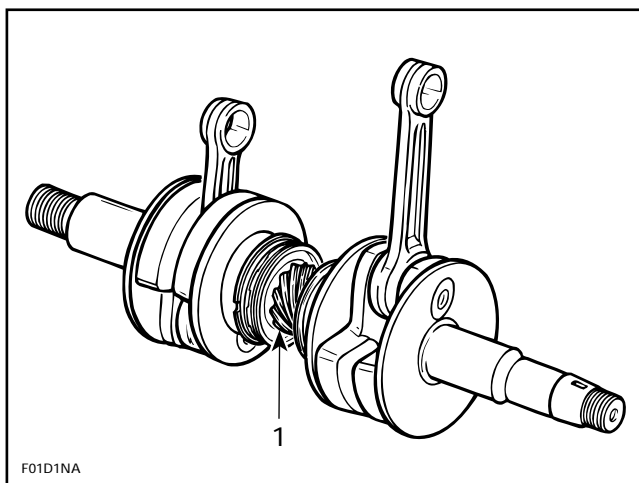
787 Engine



○ NOTE : Some numbers are missing. They are used on the previous illustration.

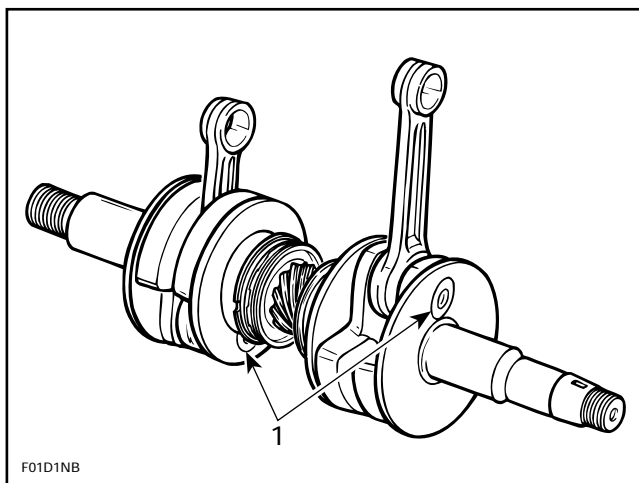
CRANKSHAFT MISALIGNMENT AND DEFLECTION

Since it is an assembled crankshaft it can become misaligned or deflected. Crankshaft can be twisted on center main journal, changing timing of 1 cylinder in relation with the other.



1. Main journal alignment here

Counterweights can also be twisted on connecting rod journal on any or both cylinder(s).



1. Connecting rod journal alignment here

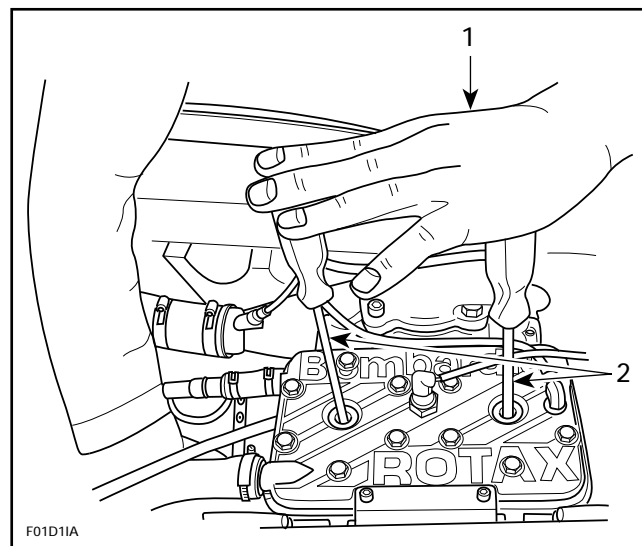
Crankshaft Alignment at Center Main Journal

NOTE : The following checks can be performed with engine in watercraft without overhauling engine.

To quickly check, without accuracy, if crankshaft is twisted on center main journal, proceed as follows:

- Remove PTO flywheel guard.

- Remove spark plugs.
- Insert a screwdriver in one spark plug hole.
- Insert a longer screwdriver in the other hole.
- Lay a forearm over both screwdriver handles to feel piston displacements.
- With the other hand, slowly rotate engine by PTO flywheel.



1. Lay 1 hand over screwdrivers to feel movement
2. Screwdrivers in spark plug holes

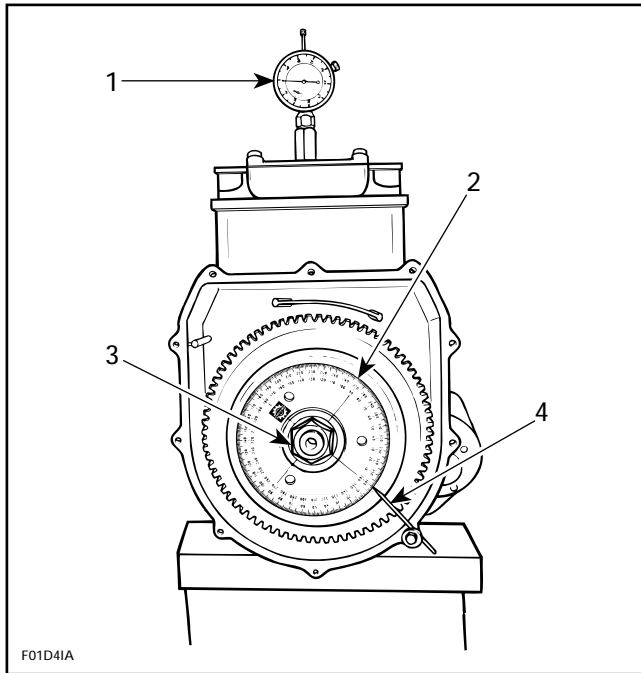
As soon as one piston starts going up, the other must immediately go down. Any interval between strokes indicates a misaligned crankshaft.

Or, to accurately check crankshaft alignment, proceed as follows:

- Remove ignition housing cover.
- Remove MAG flywheel nut. Refer to PTO FLYWHEEL AND MAGNETO 04-03 for procedures.
- Install Bombardier degree wheel (P / N 295 000 007) on crankshaft end. Hand-tighten nut only.
- Remove both spark plugs.
- Install a TDC gauge (P / N 295 000 065) in spark plug hole on **MAG** side.
- Bring **MAG** piston at Top Dead Center.
- As a needle pointer, secure a wire with a cover screw and a washer.
- Rotate degree wheel (NOT crankshaft) so that needle pointer reads 360°.

Section 04 ENGINE

Sub-Section 04 (BOTTOM END)



1. TDC gauge
2. Degree wheel
3. Hand tighten nut
4. Needle pointer

– Remove TDC gauge and install on **PTO side**.

– Bring **PTO piston** at Top Dead Center.

Interval between cylinders must be exactly 180° therefore, needle pointer must indicate 180° on degree wheel ($360^\circ - 180^\circ = 180^\circ$).

Any other reading indicates a misaligned crankshaft.

Crankshaft Alignment at Connecting Rod Journal

Such misalignment may cause a crankshaft hard to be manually turned. Verification can be done by measuring deflection each end of crankshaft. Refer to INSPECTION paragraph.

If deflection is found greater than specified tolerance, this indicates worn bearing(s), bent and / or disaligned crankshaft.

GENERAL

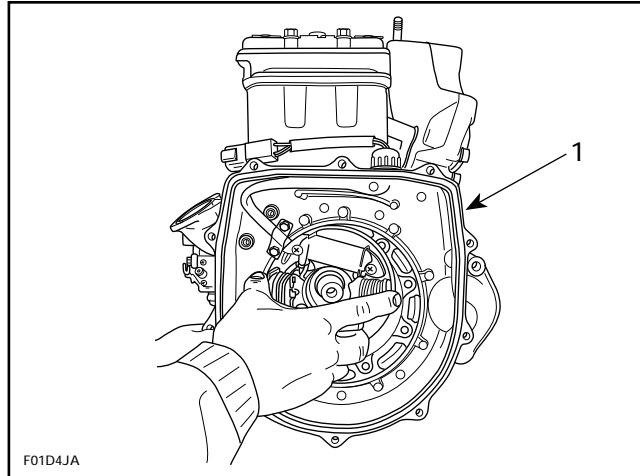
Engine has to be removed from boat to open bottom end.

If crankshaft end seal(s) has / have to be replaced, bottom end must be opened except for **MAG** side seal on **787 engine**.

DISASSEMBLY

Remove the following parts:

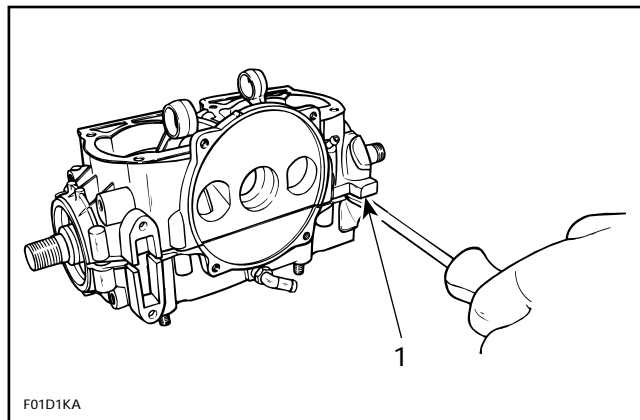
- Ignition housing and PTO flywheel on opposite side.



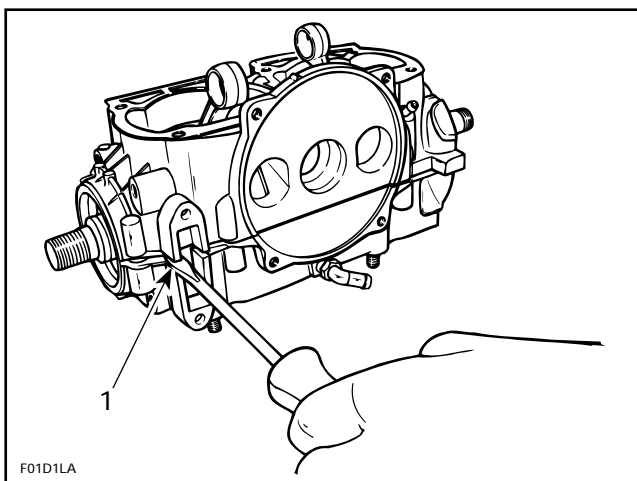
1. Separating ignition housing / armature plate from crankcase

- Rotary valve cover and valve.
- Engine support.
- Crankcase retaining screws.

Insert screwdrivers between crankcase lugs and pry to separate halves being careful not to damage precision machined surfaces.



1. Separate halves by prying at provided lugs



1. Separate halves by prying at provided lugs

Remove counter balance shaft and crankshaft on 787 engine.

1,2,3,4, Seal and Bearing

NOTE : Do not needlessly remove crankshaft bearings.

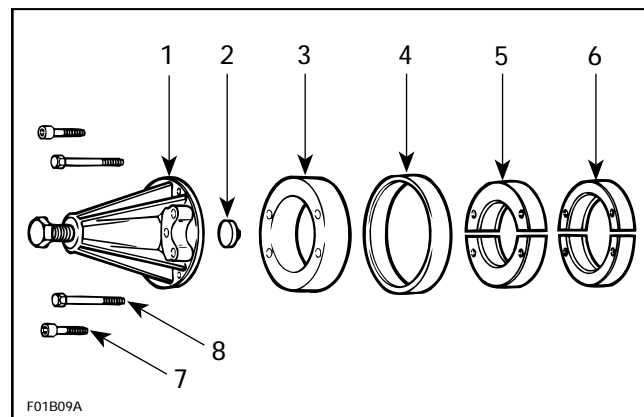
Remove end seal(s).

To remove end bearings from crankshaft, use crankshaft end protective cap (P / N 290 876 557) and puller (P / N 290 876 298).

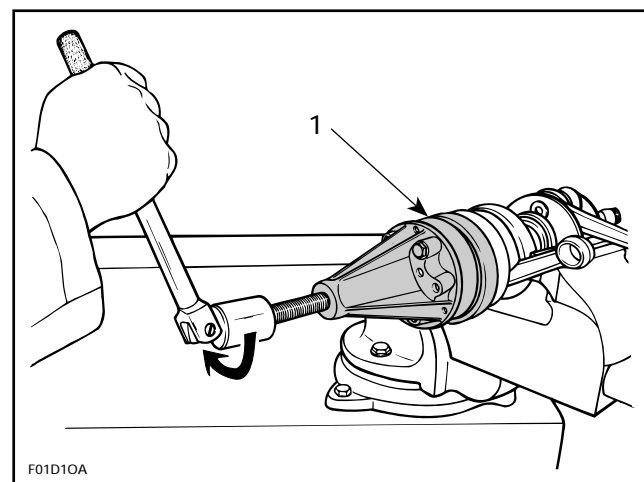
On PTO side, use ring (P / N 290 977 490) with ring halves (P / N 290 977 475).

On MAG side, use distance ring (P / N 290 876 569) and ring (P / N 290 977 490) with ring halves (P / N 290 276 025).

NOTE : To facilitate ring or distance ring installation lubricate their inside diameters.

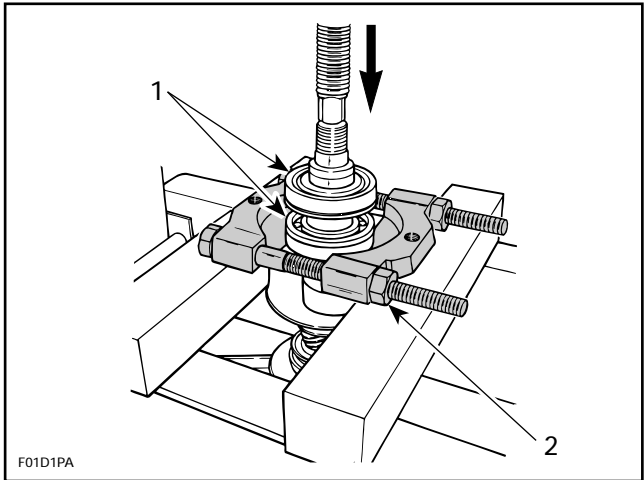


1. Puller (P / N 290 876 298)
2. Protective cap (P / N 290 876 557)
3. Distance ring, MAG side (P / N 290 876 569)
4. Ring (both side) (P / N 290 977 490)
5. AG side ring halves (P / N 290 276 025)
6. PTO side ring halves (P / N 290 977 475)
7. Screw M8 x 40 (P / N 290 840 681)
8. Screw M8 x 70 (P / N 290 841 201)



1. Removing crankshaft bearing

Or, use a bearing extractor such as Proto no. 4332 and a press to remove 2 bearings at a time.



- 1. Press bearings out
- 2. Bearing extractor

NOTE : If bearings are to be replaced, they can be quickly removed using an air hammer

787 Engine

Bearings can be removed by using puller (P / N 290 876 298), ring halves (P / N 290 876 330) and ring (P /pN 290 977 480).

CLEANING

All Engines

Discard all oil seals, gaskets, O-rings and sealing rings.

Clean water and oil passages and make sure they are not clogged.

Clean all metal components in a solvent.

Remove old Loctite from crankcase mating surfaces with stripper (P / N 295 500 110).

CAUTION : Never use a sharp object to scrape away old sealant as score marks incurred are detrimental to crankcase sealing.

INSPECTION

Visually inspect parts for corrosion damage.

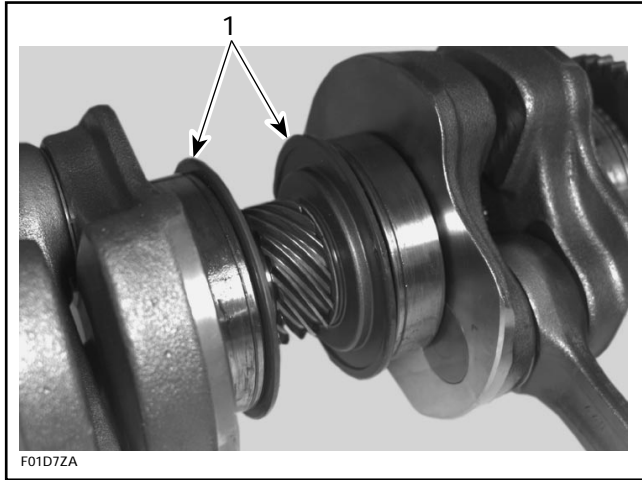
Inspect plane surfaces for warpage. Small deformation can be corrected by grinding surface with a fine sand paper. Install sand paper on a surface plate and rub part against oiled sand paper.

Inspect crankshaft bearings. Check for scoring, pitting, chipping or other evidence of wear. Make sure plastic cage is not melted. Rotate and make sure they turn smoothly.

If crankshaft and / or components are found defective, it must be repaired by a specialized shop or replaced.

787 Engine

New oil seals do not necessitate the use of a cage.



- 1. Seals

Counterbalance Shaft

Inspect condition of bearings, gear and seals.

If gear or oil seals need servicing, counterbalance shaft must be factory-repaired.

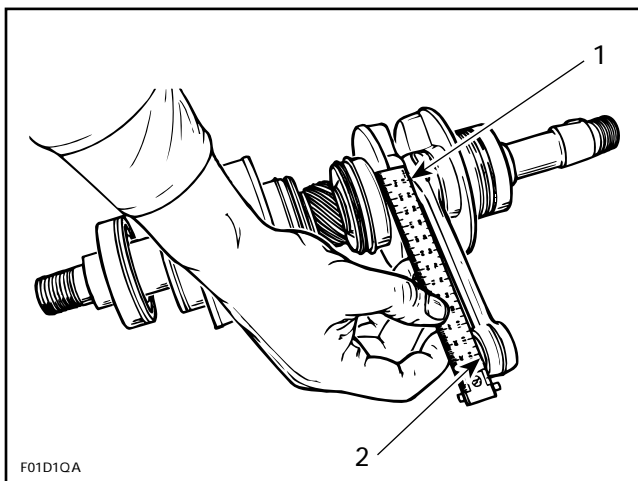
All Engines

The inspection of engine bottom end should include the following measurements :

MEASUREMENT	TOLERANCES		
	NEW PARTS (min.) (max.)		WEAR LIMIT
Crankshaft deflection center	N.A.	N.A.	0.08 mm (.0031 in)
MAG side	N.A.	N.A.	0.05 mm (.002 in)
PTO side	N.A.	N.A.	0.03 mm (.001 in)
Connecting rod big end axial play	0.39 mm (.015 in)	.737 mm (.029 in)	1.2 mm (.047 in)

Connecting Rod Straightness

Align a steel ruler on edge of small end connecting rod bore. Check if ruler is perfectly aligned with edge of big end.



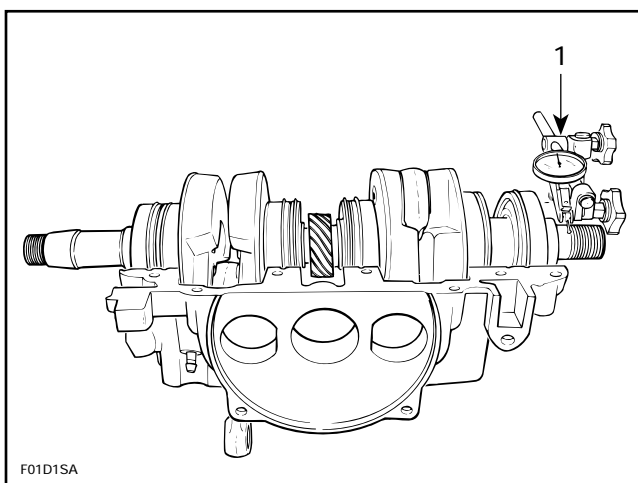
1. Ruler must be aligned with edge of connecting rod here
2. Align ruler here

Crankshaft Deflection

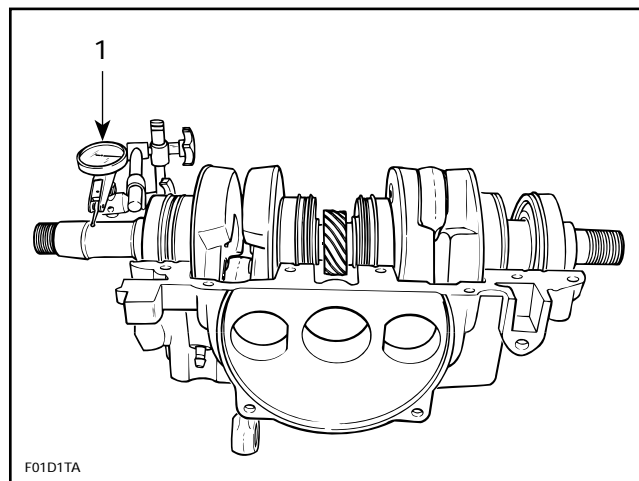
NOTE : Crankshaft deflection can not be correctly measured between centers of a lathe.

Crankshaft deflection is measured each end with a dial indicator.

First, check deflection with crankshaft in crankcase. If deflection exceeds the specified tolerance, it can be either ball bearings wear, bent or twisted crankshaft at connecting rod journal.

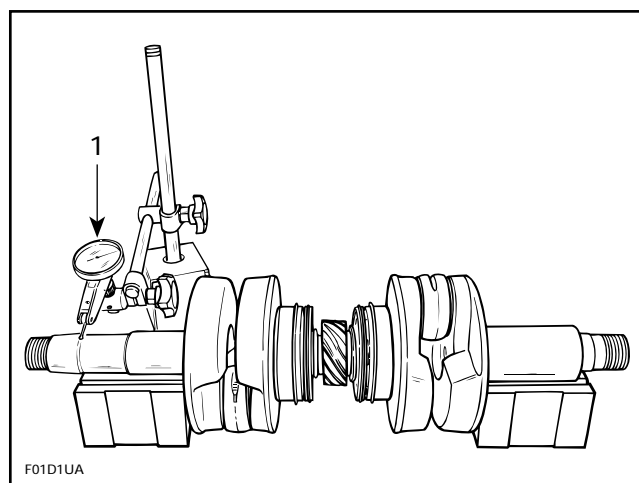


1. Measuring PTO side deflection in crankcase

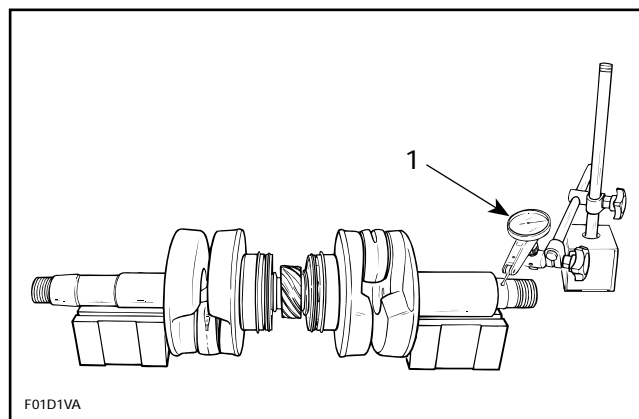


1. Measuring MAG side deflection in crankcase

Remove crankshaft bearings and check deflection again on V-shaped blocks as illustrated.



1. Measuring MAG side deflection on V-shaped blocks

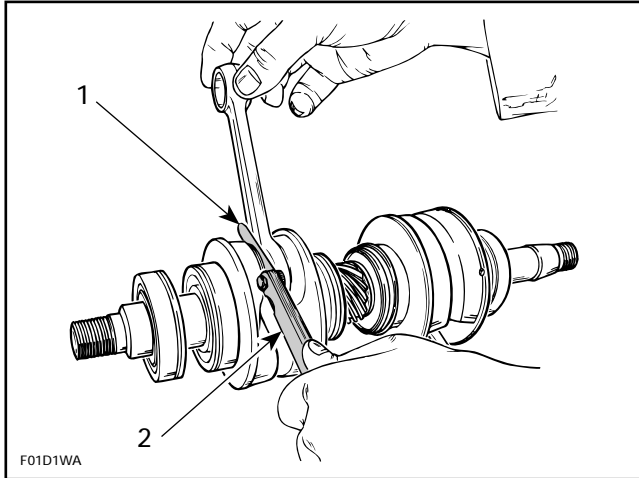


1. Measuring PTO side deflection on V-shaped blocks

If the deflection exceeds the specified tolerance, crankshaft should be repaired or replaced.

Connecting Rod Big End Axial Play

Using a feeler gauge, measure distance between thrust washer and crankshaft counterweight.



1. Measuring big end axial play
2. Feeler gauge

ASSEMBLY

Assembly is essentially the reverse of disassembly procedures. However pay particular attention to the following.

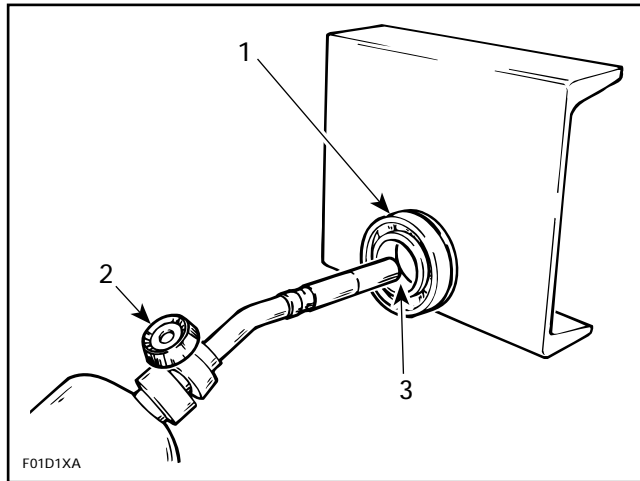
2,3,6, Bearing and Crankshaft

Apply Loctite 767 Anti-Seize on part of crankshaft where bearing fits.

Prior to installation, place bearings into a container filled with oil, previously heated to 75°C (167°F). This will expand bearing and ease installation.

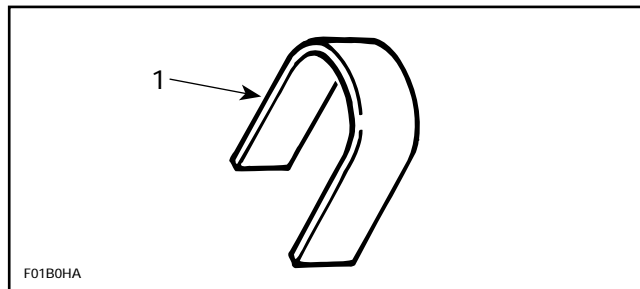
Or, as an alternate method, apply heat with a propane torch. Lay bearing on a steel plate, then heat plate through bearing bore until smoke is noticed from bearing. Install bearing carefully on crankshaft.

▼ **CAUTION :** Immediately stop heating as soon as smoke is noticed. Overheating bearing will melt plastic cage. Practice with used bearings on first try.

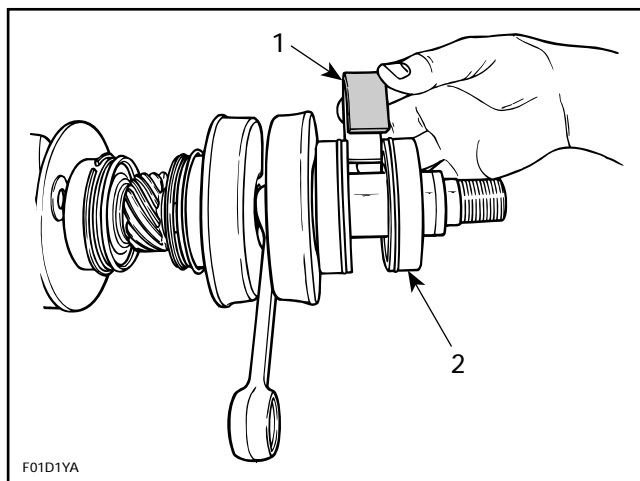


1. Bearing against a steel plate
2. Propane torch
3. Heat plate through bearing bore

To properly locate outer PTO bearing, temporarily install distance gauge (P / N 290 876 827 for 717 engine and 290 876 828 for 787 engine) against inner bearing. Slide outer bearing until stopped by gauge then remove gauge.



1. Distance gauge



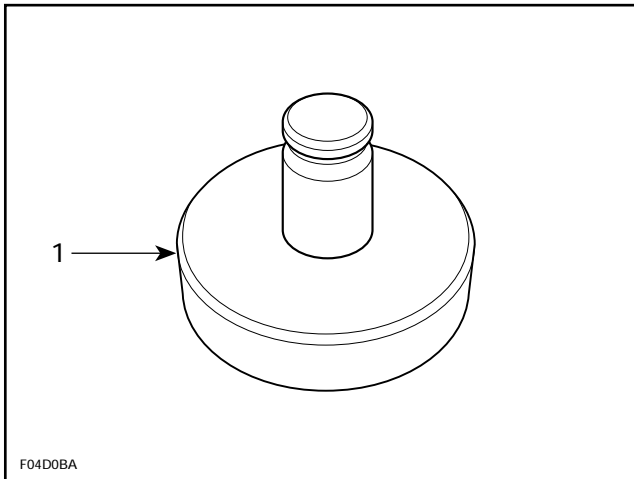
TYPICAL

1. Distance gauge
2. PTO side outer bearing

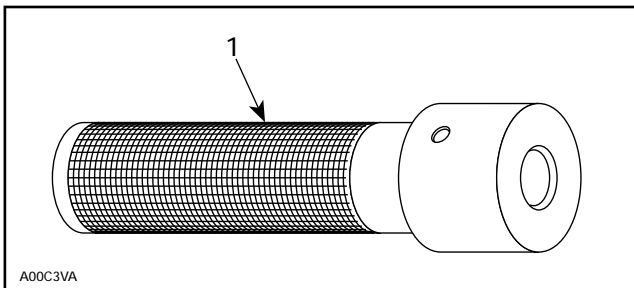
1,4 Seal

At seal assembly, apply a light coat of lithium grease on seal lips.

On **787 engine**, use a pusher (P / N 290 877 740) and an handle (P / N 420 877 650) to install seal in ignition housing.



1. Seal pusher



1. Handle



787 Engine

5, Drive Pin

Make sure drive pins of bearings are properly installed in crankcase recesses at assembly.

7, Crankcase

Crankcase halves are factory matched and therefore, are not interchangeable or available as single halves.

Prior to joining crankcase halves, apply a light coat of Loctite 515 on mating surfaces. Do not apply in excess as it will spread out inside crankcase.

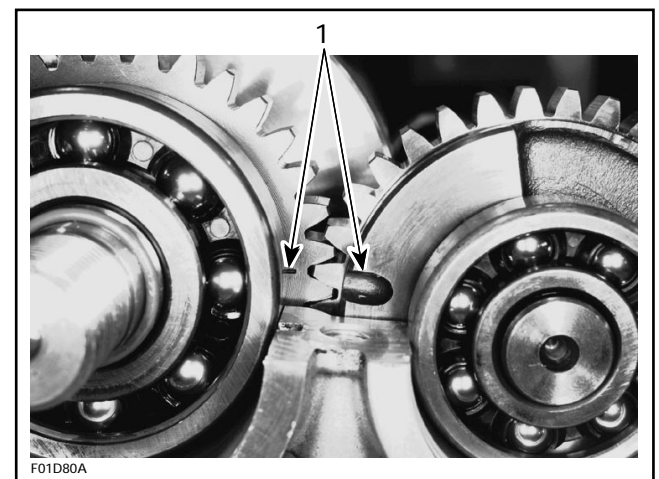
NOTE : On aluminum material it is recommended to use Loctite Primer N to reduce curing time and increase gap filling capability. Refer to manufacturer's instructions.

CAUTION : Rotary valve shaft must be installed in crankcase before closing halves. Before joining crankcase halves, make sure that crankshaft gear is well engaged with rotary valve shaft gear. Make sure drive pins of bearings are properly installed in crankcase recesses.

787 Engine

Install crankshaft first in crankcase.

After crankshaft installation, install counterbalance shaft. Make sure to properly index crankshaft and counterbalance shaft by aligning marks of gears.



1. Marks

All Engines

Position crankcase halves together and hand-tighten bolts.

Section 04 ENGINE

Sub-Section 04 (BOTTOM END)

▼ **CAUTION :** On 717 engine, temporarily install armature plate to align crankcase halves with each other.

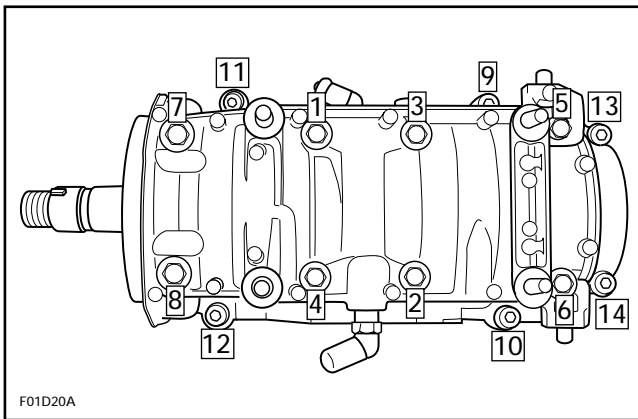
8,9, Screw

Apply Loctite 515 on screw threads and synthetic grease below head screws.

717 Engine

8,9,10, Screw

Torque crankcase screws to 24 N•m (17 lbf•ft) as per following illustrated sequence.



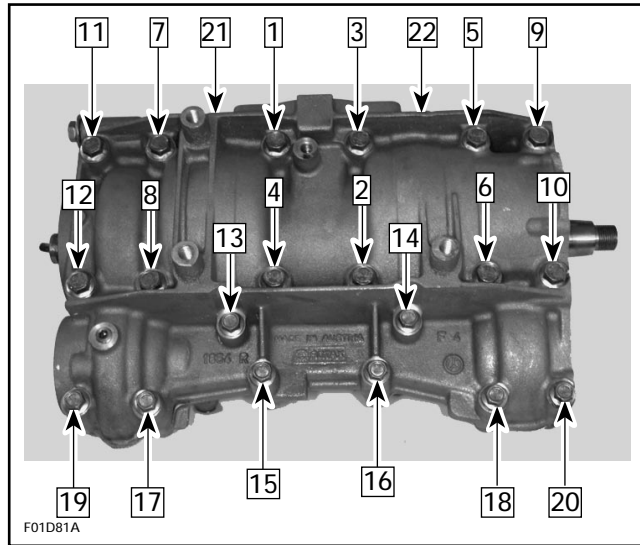
11, Stud

At assembly in crankcase, apply Loctite 271 (red) on stud threads. Torque to 12 N•m (9 lbf•ft).

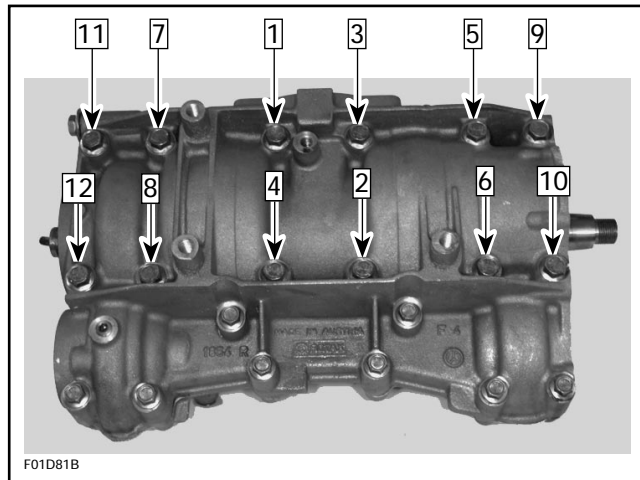
787 Engine

8,9, Screw

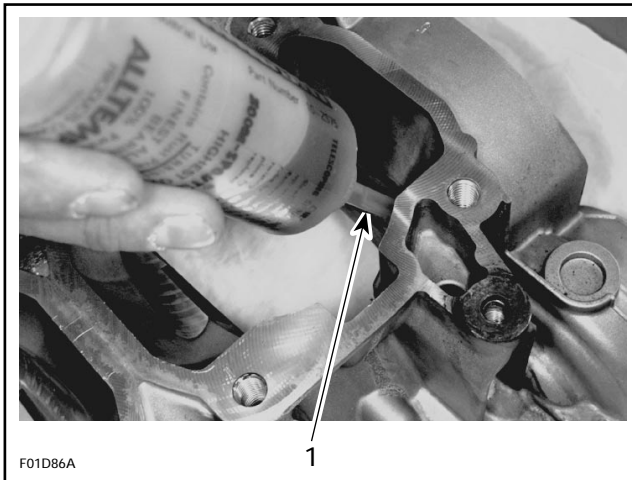
Torque crankcase screws to 12 N•m (9 lbf•ft) as per following sequence. Repeat procedure, re-tightening all screws to 24 N•m (17 lbf•ft).



As a final step, torque only M10 screws of crankcase to 40 N•m (30 lbf•ft) as per following sequence.



When bottom end is assembled, add 30 mL (1 oz) of injection oil in the small hole near the transfer of the PTO cylinder.



TYPICAL

1. Add 30 mL (1oz) of injection oil

Finalizing Assembly

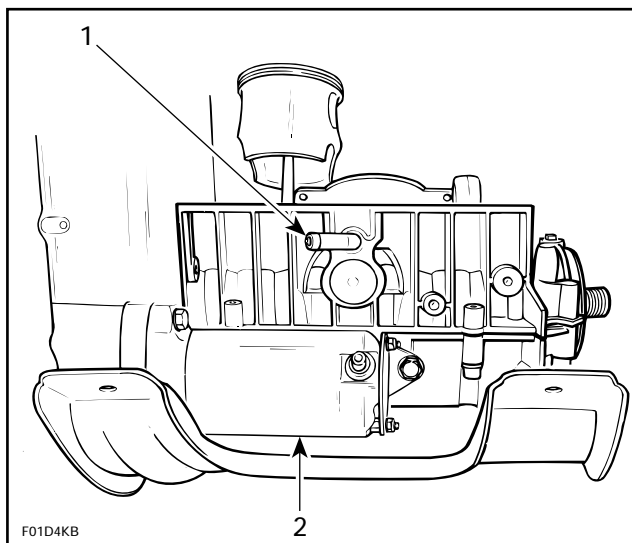
12, Oil Outlet Fitting

All Engines

If oil outlet fitting has been removed from crankcase, reinstall it with its end pointing towards ignition housing. Apply Loctite PST 592 on fitting threads.

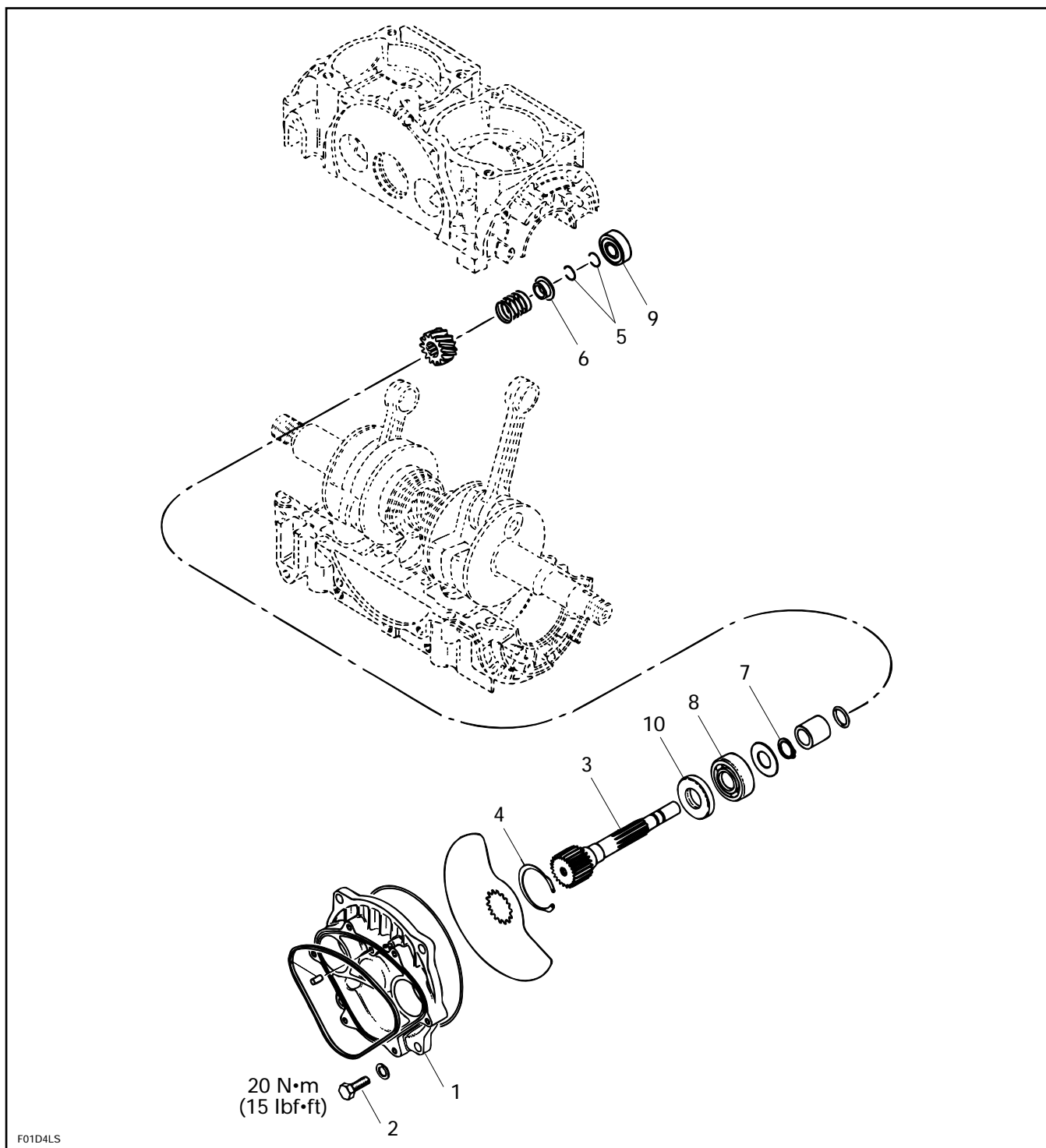
For rotary valve timing and assembly procedures, refer to ROTARY VALVE 04-05.

If engine support is installed on crankcase before ignition housing, electric starter must be installed before engine support.



1. End towards ignition housing
2. Install starter before engine support

ROTARY VALVE



GENERAL

The following verification procedures such as clearance of rotary valve cover or rotary valve shaft gear backlash can be performed without removing engine from boat. Refer to INSPECTION further in this section.

However engine must be removed from boat to work on rotary valve shaft / components. Refer to REMOVAL AND INSTALLATION 04-01 for procedures.

Bottom end must be opened to remove rotary valve shaft.

DISASSEMBLY

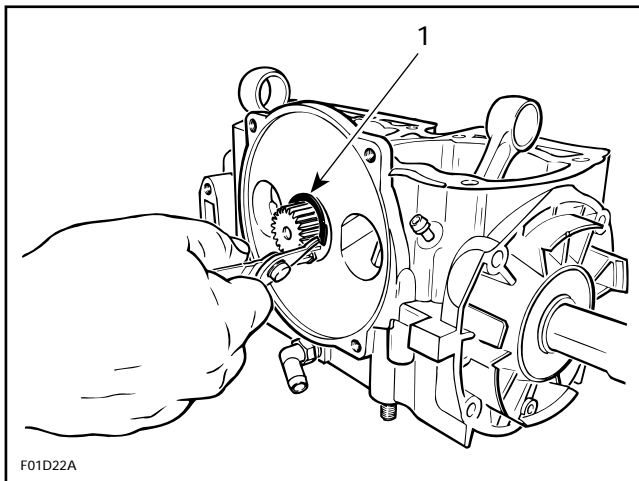
1,2, Rotary Valve Cover and Screw

Unscrew 4 retaining screws and withdraw rotary valve cover and valve.

NOTE : It is necessary to withdraw carburetors prior removing rotary valve cover. Refer to FUEL SYSTEM 06-03 then refer to Carburetor Removal.

3,4, Rotary Valve Shaft and Snap Ring

To remove rotary valve shaft assembly from crankcase, first remove snap ring from crankcase.

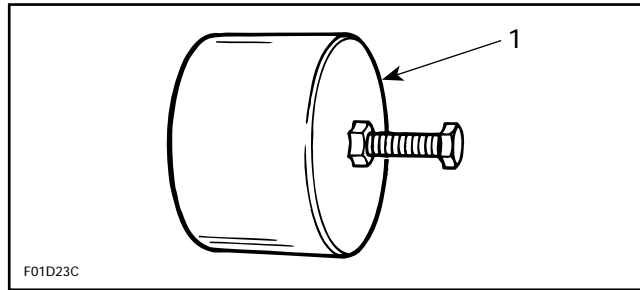


TYPICAL

1. Removing snap ring

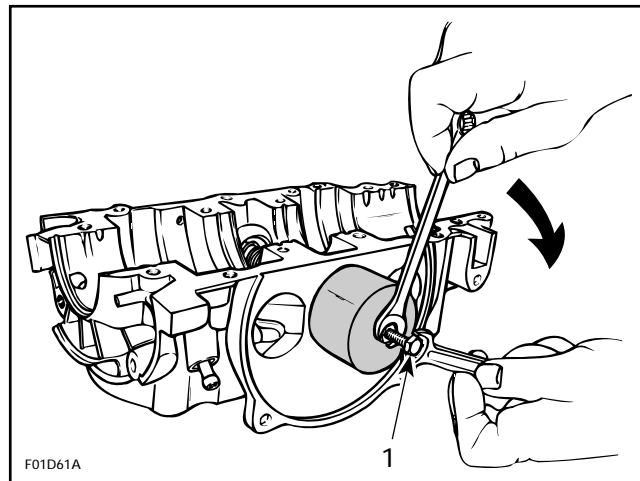
CAUTION : Bottom end must be opened to remove rotary valve shaft.

To remove rotary valve shaft, use puller (P / N 290 876 487 for 717 engine and 290 876 488 for 787 engine).



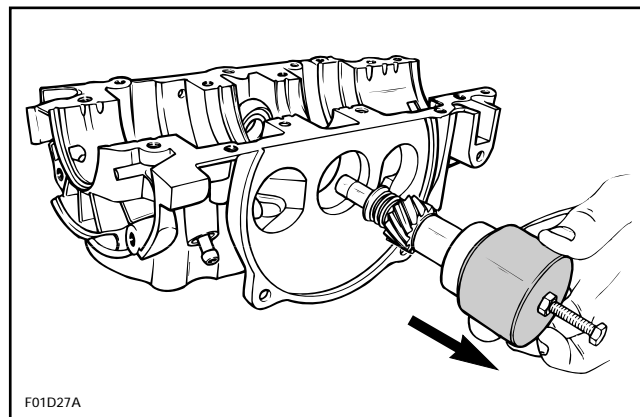
1. Rotary valve shaft remover

Place puller over rotary valve shaft end and screw on puller bolt into shaft. While retaining bolt with a wrench, turn puller nut CLOCKWISE until shaft comes out.



TYPICAL

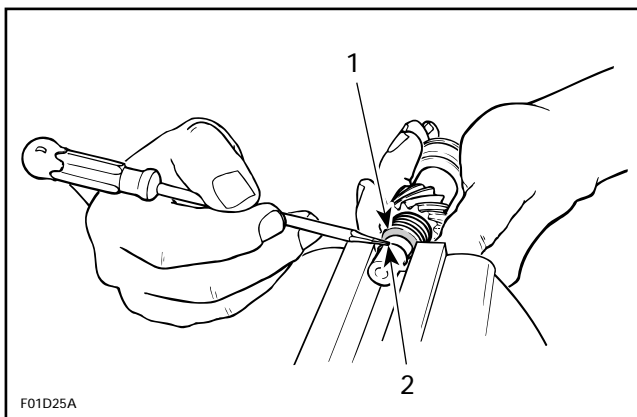
1. Hold bolt



TYPICAL

5,6, Circlip and Spring Seat

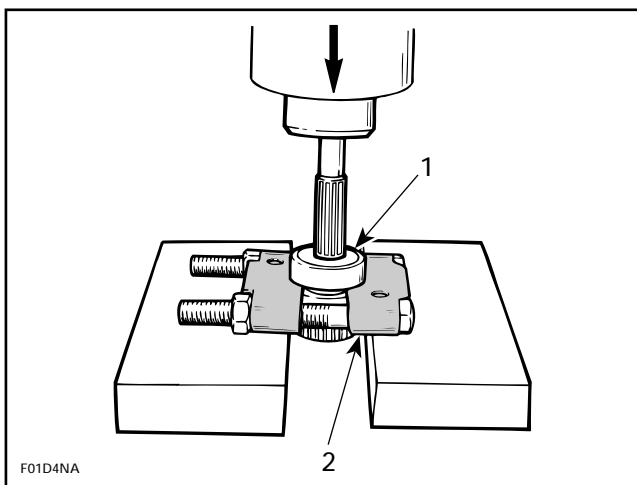
If it is necessary to disassemble components of rotary valve shaft assembly, use seat to compress spring and remove circlips.



1. Compress seat
2. Remove circlips

7,8, Snap Ring and Bearing

To remove bearing use a bearing extractor such as Snap-on no. CJ-950 as illustrated. Slide off distance sleeve, remove snap ring and press shaft out.

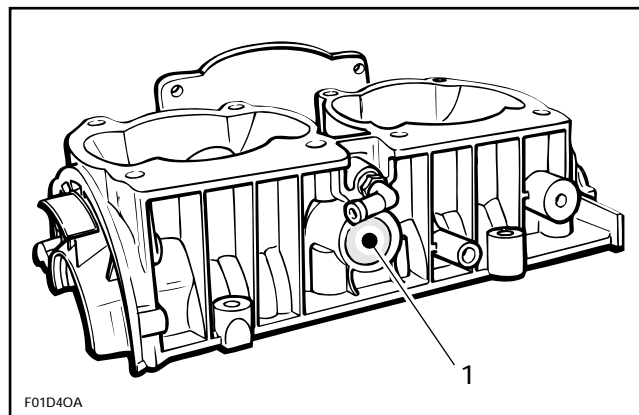


1. Bearing
2. Bearing extractor Snap-on CJ-950

CAUTION : Ensure that rotary valve shaft is perfectly perpendicular with press tip or damage will occur.

9, Bearing

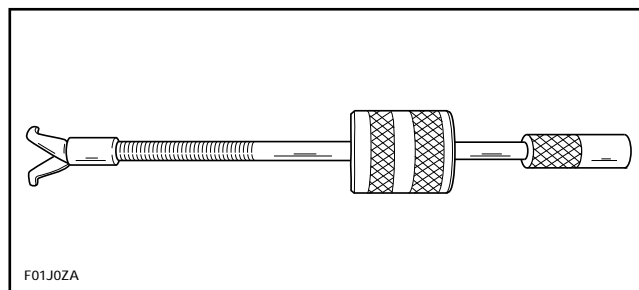
NOTE : Do not remove plug against bearing in upper crankcase half.



1. Do not remove this plug

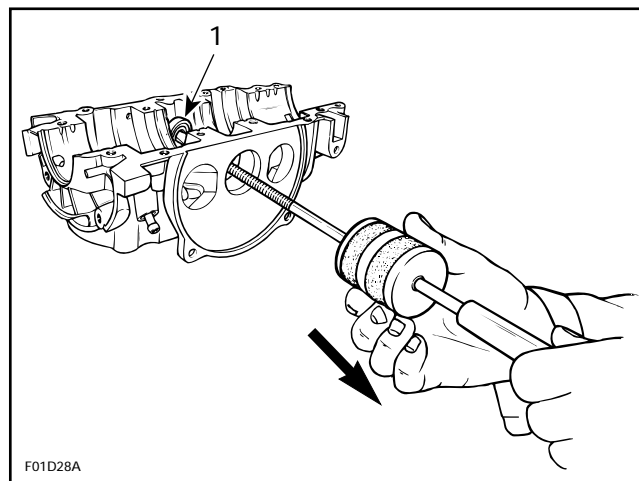
End bearing can be easily removed using the following suggested tool.

Snap-on hammer puller including : Handle CJ93-1, hammer CJ125-6 or claws CJ93-4.



Close puller claws so that they can be inserted in end bearing. Holding claws, turn puller shaft clockwise so that claws open and become firmly tight against bearing.

Slide puller sleeve outwards and tap puller end. Retighten claws as necessary to always maintain them tight against bearing. Continue this way until bearing completely comes out.



1. End bearing

CLEANING

Discard all seals and O-rings.

Clean all metal components in a solvent.

Clean oil passages and make sure they are not clogged.

Clean rotary valve shaft and inside of distance sleeve.

INSPECTION

Inspect rotary valve cover for warpage. Small deformation can be corrected by surfacing with fine sand paper on a surface plate. Surface part against oiled sand paper.

Inspect bearings. Check for scoring, pitting, chipping or other evidence of wear. Make sure plastic cage (on bigger bearing) is not melted. Rotate them and make sure they turn smoothly.

Check for presence of brass filings in gear housing.

Visually check gear wear pattern. It should be even on tooth length all around. Otherwise it could indicate a bent shaft, check deflection. Replace gear if damaged.

The inspection of rotary valve system should include the following measurements.

MEASUREMENTS	TOLERANCE	
	NEW PARTS	WEAR LIMIT
Rotary Valve / Cover Clearance	0.25 - 0.35 mm (.010 - .014 in)	0.35 mm (.014 in)
Rotary Valve Shaft Deflection	N.A.	0.08 mm (.003 in)

NOTE : The following verifications can be performed with engine in jet boat without overhauling engine.

Rotary Valve / Cover Clearance

There is a choice of 2 measuring methods :

One with a 45° feeler gauge, the other one with solder.

The clearance between the rotary valve and the cover must be 0.30 ± 0.05 mm (0.012 ± 0.002 in).

NOTE : If the clearance is below 0.25 mm (0.010 in) this could create an overheating situation and if the clearance is over 0.35 mm (0.014 in) this could create a hard starting situation.

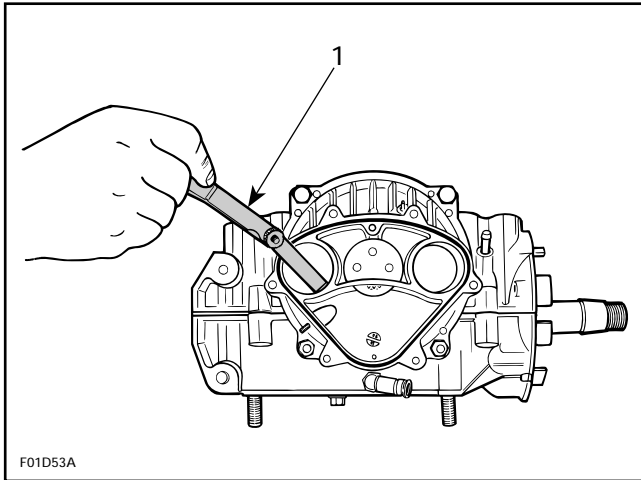
45° Feeler Gauge Method

Remove rotary valve cover and its O-ring.

Reinstall cover in place WITHOUT its O-ring and torque screws to 20 N•m (15 lbf•ft).

Feeler gauge blade from 0.25 mm (.010 in) to 0.35 mm (.014 in) thickness should fit between rotary valve and cover.

Insert feeler gauge blade through cover inlet ports to verify clearance. At least verify clearance at 2 different places in each port.



1. 45° feeler gauge

Solder Method

Remove rotary valve cover and its O-ring.

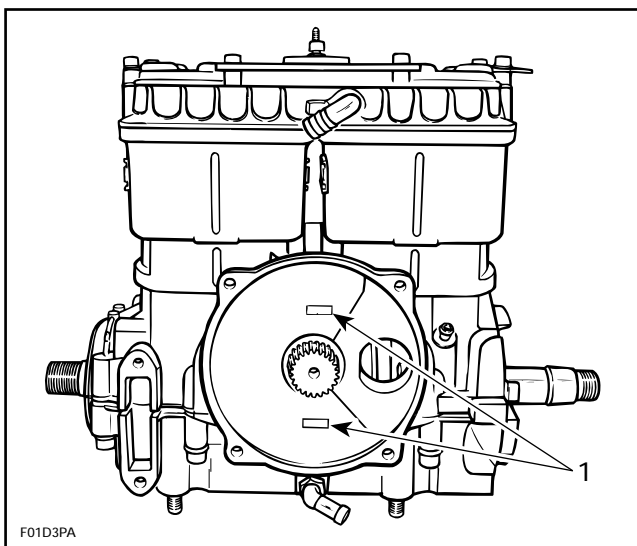
Use the following type of solder :

- rosin core
- diameter : 0.8 mm (0.032 in)
- electronic application (available at electronic stores)

Install 2 short pieces (13 mm (1/2 in) long) of solder directly on rotary valve, 1 above and 1 below rotary valve gear. Apply grease to hold solder in position.

Reinstall cover in place WITHOUT its O-ring and torque screws to 20 N•m (15 lbf•ft).

Remove cover then clean and measure compressed solder thickness, it must be within the specified tolerance 0.30 ± 0.05 mm ($0.012 \pm .002$ in).



TYPICAL
1. Solder

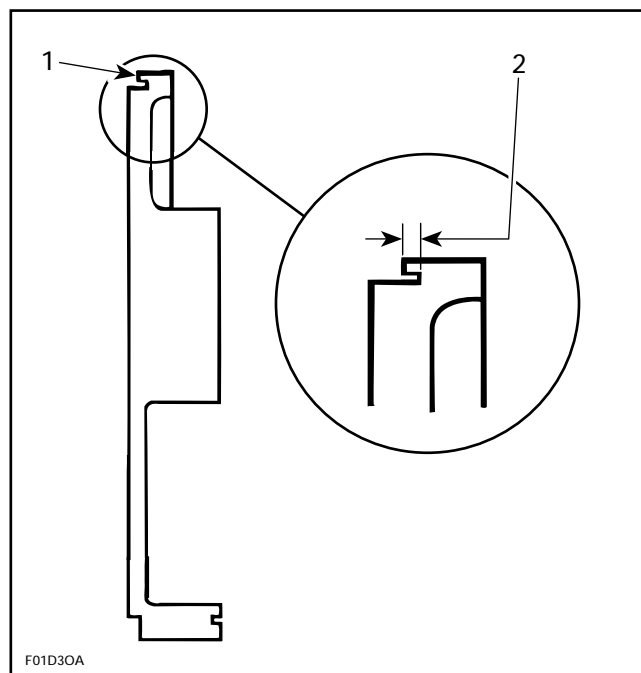
If rotary valve cover clearance is out of specification, machine rotary valve cover seating surface or replace the cover.

Machining Information

The amount of material over tolerance must be removed from the rotary valve cover seating surface.

Also cut the O-ring groove an equal amount to obtain $1.0 \pm .03 \text{ mm}$ ($.039 \pm .001 \text{ in}$) between the bottom of the groove and the seating surface.

Remove burrs on the edges of the seating surface and O-ring groove.



SAME AMOUNT REMOVED FROM COVER SEATING SURFACE AND O-RING GROOVE BASE

1. Cover seating surface
2. O-ring groove depth must be $1.0 \pm .03 \text{ mm}$ ($.039 \pm .001 \text{ in}$)

Reverify the clearance.

At assembly the rotary valve timing must remain as per original setting.

NOTE : If rotary valve crankcase surface is worn, it is possible to have it rework at the factory. Contact Bombardier service department.

Rotary Valve Shaft Gear Backlash

Remove PTO flywheel guard.

Remove spark plugs, rotary valve cover and valve.

Manually feel backlash at 1 position, then turn crankshaft about 1/8 turn and recheck. Continue this way to complete 1 revolution.

Backlash must be even at all positions. Otherwise overhaul engine to find which part is faulty (gear, rotary valve shaft or crankshaft with excessive deflection).

Rotary Valve Shaft Deflection

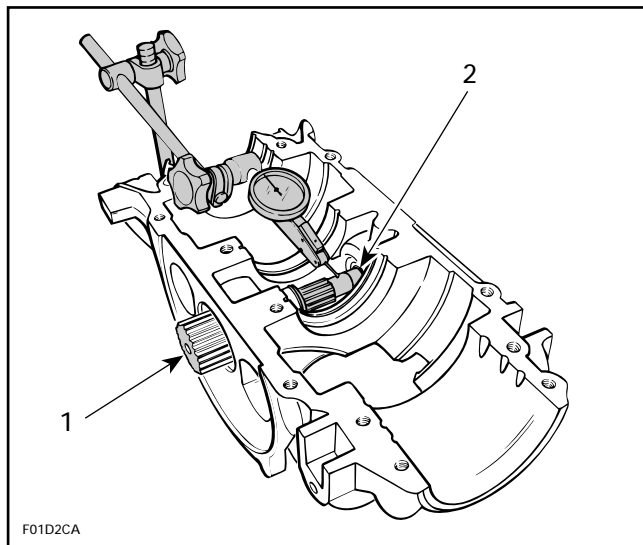
Deflection is measured with a dial gauge. Install rotary valve shaft in crankcase half, without its gear.

NOTE : End bearing must be in crankcase half.

Section 04 ENGINE

Sub-Section 05 (ROTARY VALVE)

Measure shaft deflection near gear mounting area.



TYPICAL

1. Rotary valve shaft
2. End bearing in place

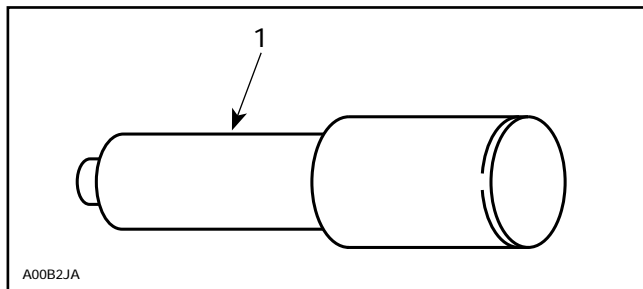
Deflection must not exceed specified value. Replace shaft as necessary.

ASSEMBLY

Assembly is essentially the reverse of disassembly procedures. However pay particular attention to the following.

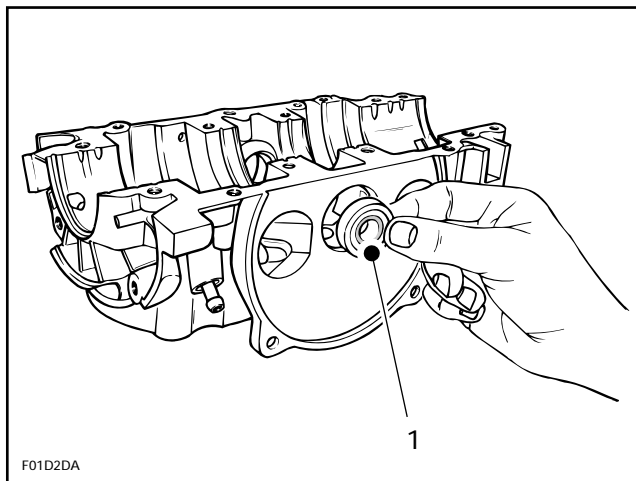
1, Bearing

To install end bearing in crankcase, use a pusher (P / N 290 876 500).



1. Pusher

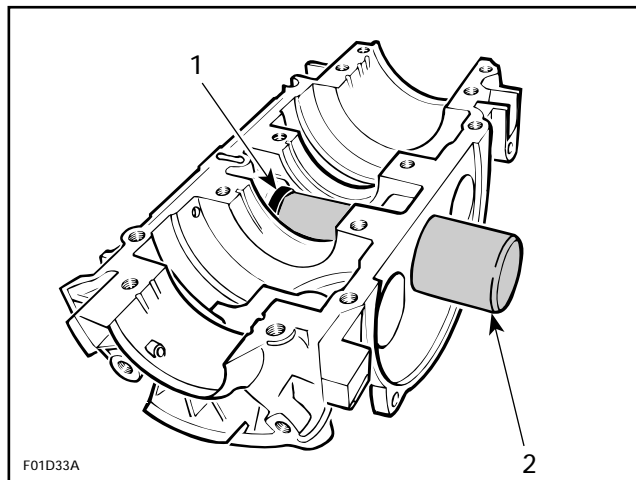
Position ball bearing shielded side towards rotary valve.



TYPICAL

1. Shielded side here (towards gear)

Push bearing until it stops on its seat.

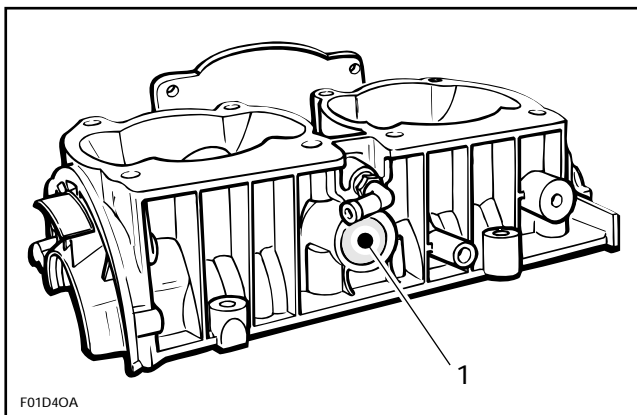


TYPICAL

1. Bearing
2. Pusher



NOTE : Do not remove plug against bearing in crankcase half.



TYPICAL

1. Plug

If plug has been removed, clean plug and crankcase hole with Loctite Safety Primer (P / N 293 800 019).

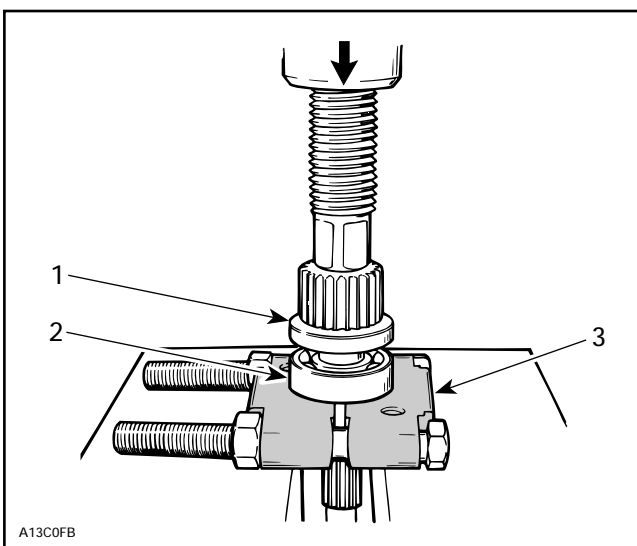
Apply Loctite Primer "T" and Loctite 648 (green) inside crankcase hole, then press plug into crankcase.

3,10, Rotary Valve Shaft and Seal

Apply lithium grease on seal lips. Position seal with shielded portion against shaft splines.

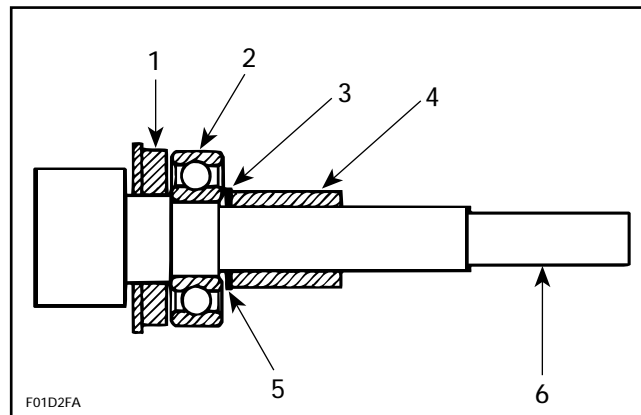
3,7,8, Rotary Valve Shaft, Snap Ring and Bearing

Install ball bearing as illustrated.



1. Seal
2. Ball bearing
3. Bearing extractor Snap-on CJ-950

Install shim, snap ring and slide distance sleeve on shaft.



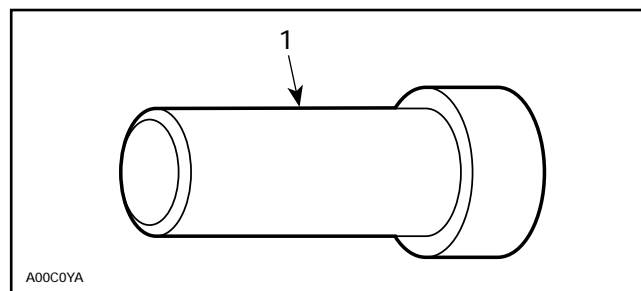
1. Seal
2. Ball bearing
3. Snap ring
4. Distance sleeve
5. Shim 0.5 mm (.020 in)
6. Rotary valve shaft

3,4, Rotary Valve Shaft Ass'y and Snap Ring

▼ CAUTION : Crankcase halves must be separated and crankshaft must not be present to install rotary valve shaft ass'y in crankcase.

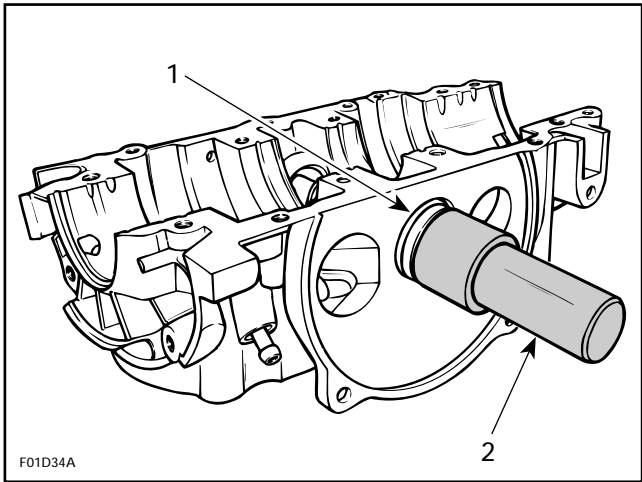
717 Engine

To install rotary valve shaft in crankcase, use a pusher (P / N 290 876 605).



1. Pusher

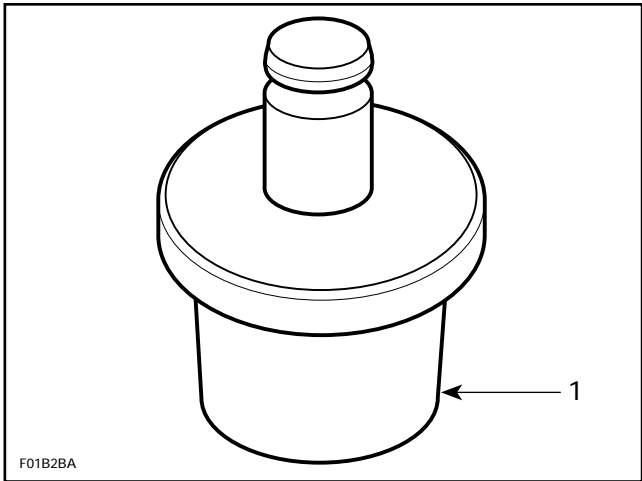
Push shaft until it stops on bearing seat.



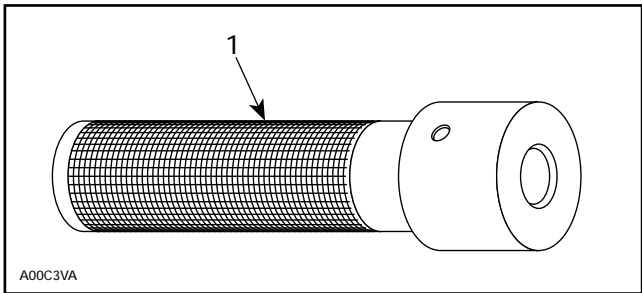
- 1. Rotary valve shaft ass'y
- 2. Push shaft until it stops

787 Engine

To install rotary valve in crankcase, use a pusher (P / N 290 876 609) with an handle (P / N 420 877 650).



- 1. Shaft pusher



- 1. Handle



All Engines

At snap ring installation, position it so that its sharp edge faces outwards.

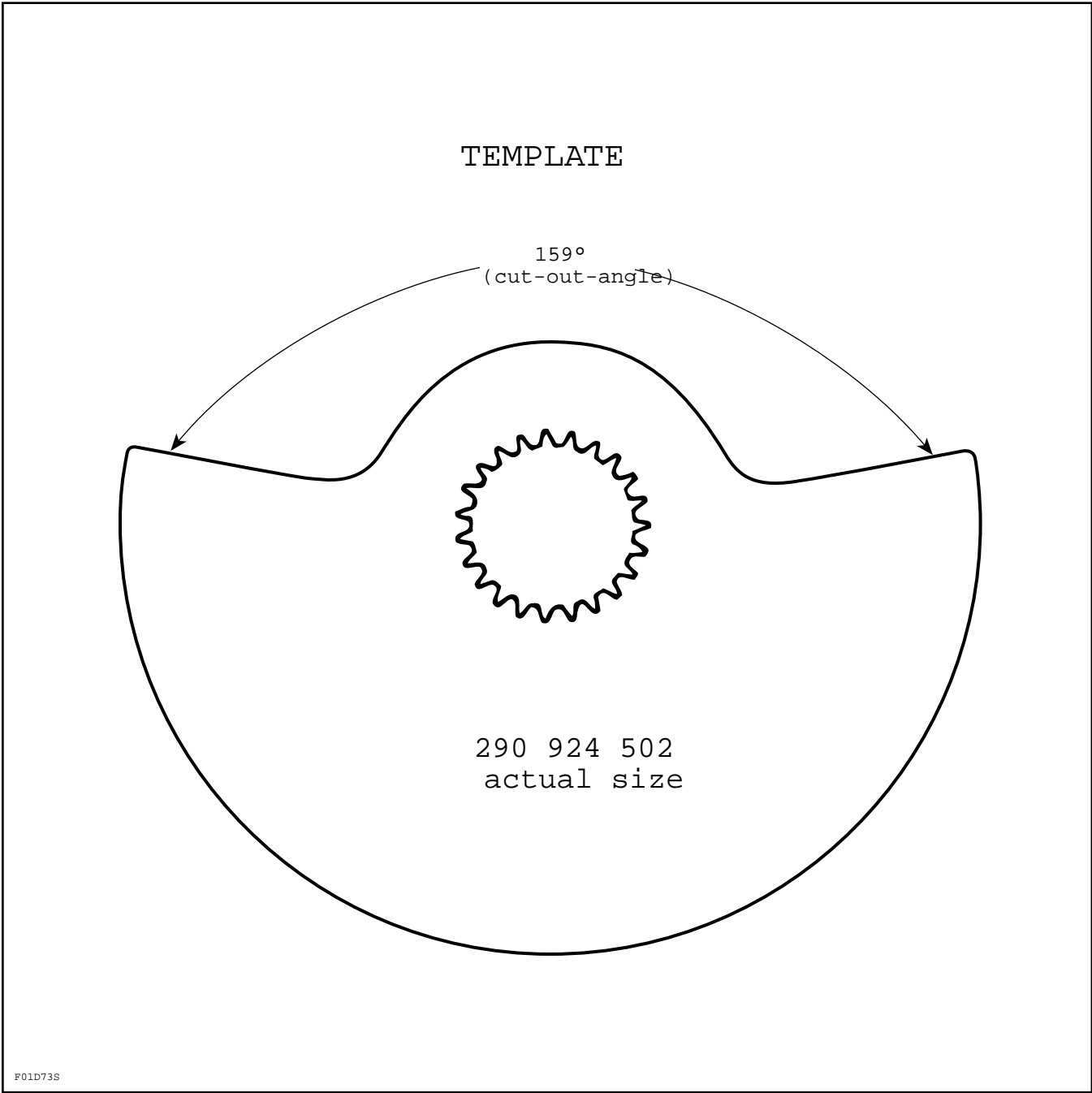
ROTARY VALVE

The rotary valve controls the opening and closing of the inlet ports. Therefore its efficiency will depend on the precision of its installation.

Identification of the Rotary Valve

Engine type	Rotary Valve P / N	Valve Duration
All	290 924 502	159°

There is no identification code on the valves. To find out the duration, place an angle finder on the valve and measure the valve cut-out angle or use the following template :

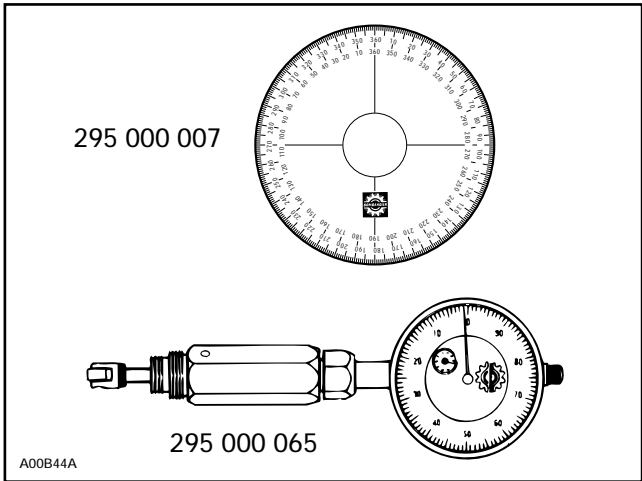


TEMPLATE

Rotary Valve Timing

▼ CAUTION : Never use the ridge molded in crankcase as a timing mark.

The following tools are required to measure rotary valve opening and closing angles in relation with MAG side piston.



Rotary valve must be set so that timing occurs as follows :

ENGINE TYPE	TIMING	
	OPENING BTDC	CLOSING ATDC
717	147 ± 5°	65 ± 5°
787	146.5 ± 5°	64 ± 5°

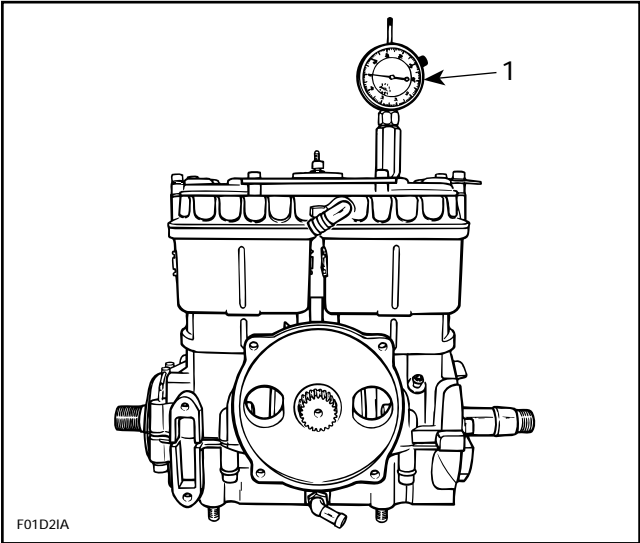
For the following instructions, let's use these specifications as example :

OPENING : 130° BTDC

CLOSING : 65° ATDC

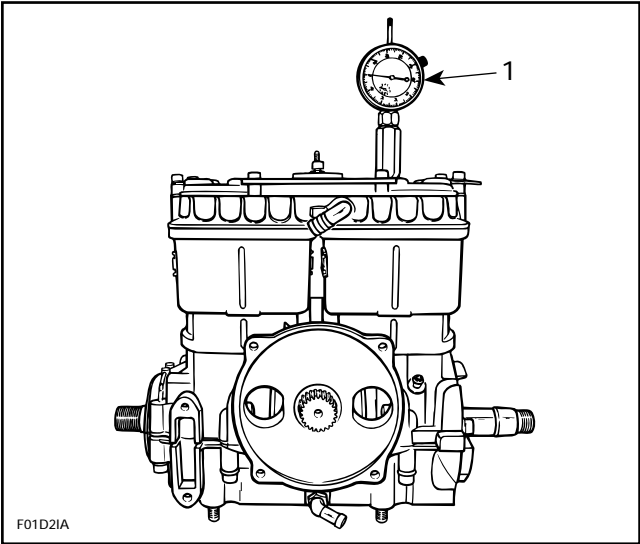
Proceed as follows :

- Turning crankshaft, bring **MAG side** piston to Top Dead Center using a TDC gauge.



1. TDC gauge on MAG side. Bring piston to TDC

- For **opening** mark, first align 360° line of degree wheel with **BOTTOM** of **MAG side** inlet port. Then, find 130° line on degree wheel and mark crankcase at this point.

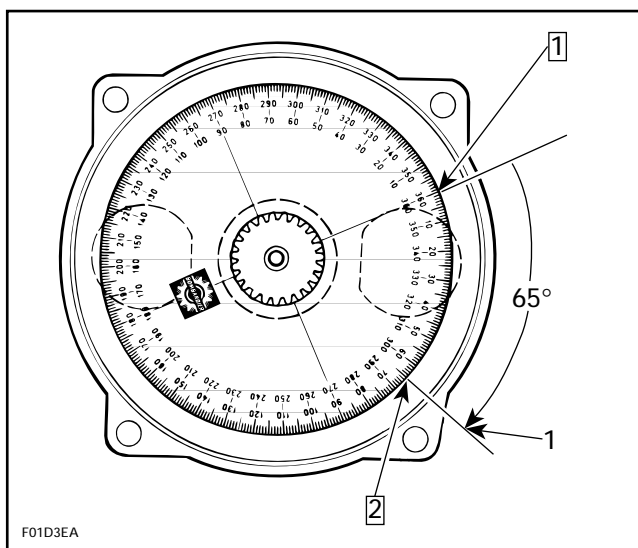


EXAMPLE

- Step 1 : Bottom of MAG inlet port. Align 360° line of degree wheel here
- Step 2 : Find 130° on degree wheel and mark here
1. Opening mark

○ NOTE : Do not rotate the crankshaft.

- For **closing** mark, first align 360° line of degree wheel with **TOP** of **MAG side** inlet port. Then, find 65° line on degree wheel and mark crankcase at this point.



EXAMPLE

Step 1 : Top of MAG inlet port. Align 360° line of degree wheel here

Step 2 : Find 65° on degree wheel and mark here

1. Closing mark

- Remove degree wheel.
- Position rotary valve on shaft splines to have edges as close as possible to these marks with the MAG piston at TDC.

NOTE : Rotary valve is asymmetrical. Therefore, try flipping it over then reinstall on splines to obtain best installation position.

Apply BOMBARDIER injection oil on rotary valve before reassembling rotary valve cover.

- Remove TDC gauge.

1,2, Rotary Valve Cover and Screw

Install O-ring and cover then torque screws to 20 N•m (15 lbf•pi) in a criss-cross sequence.

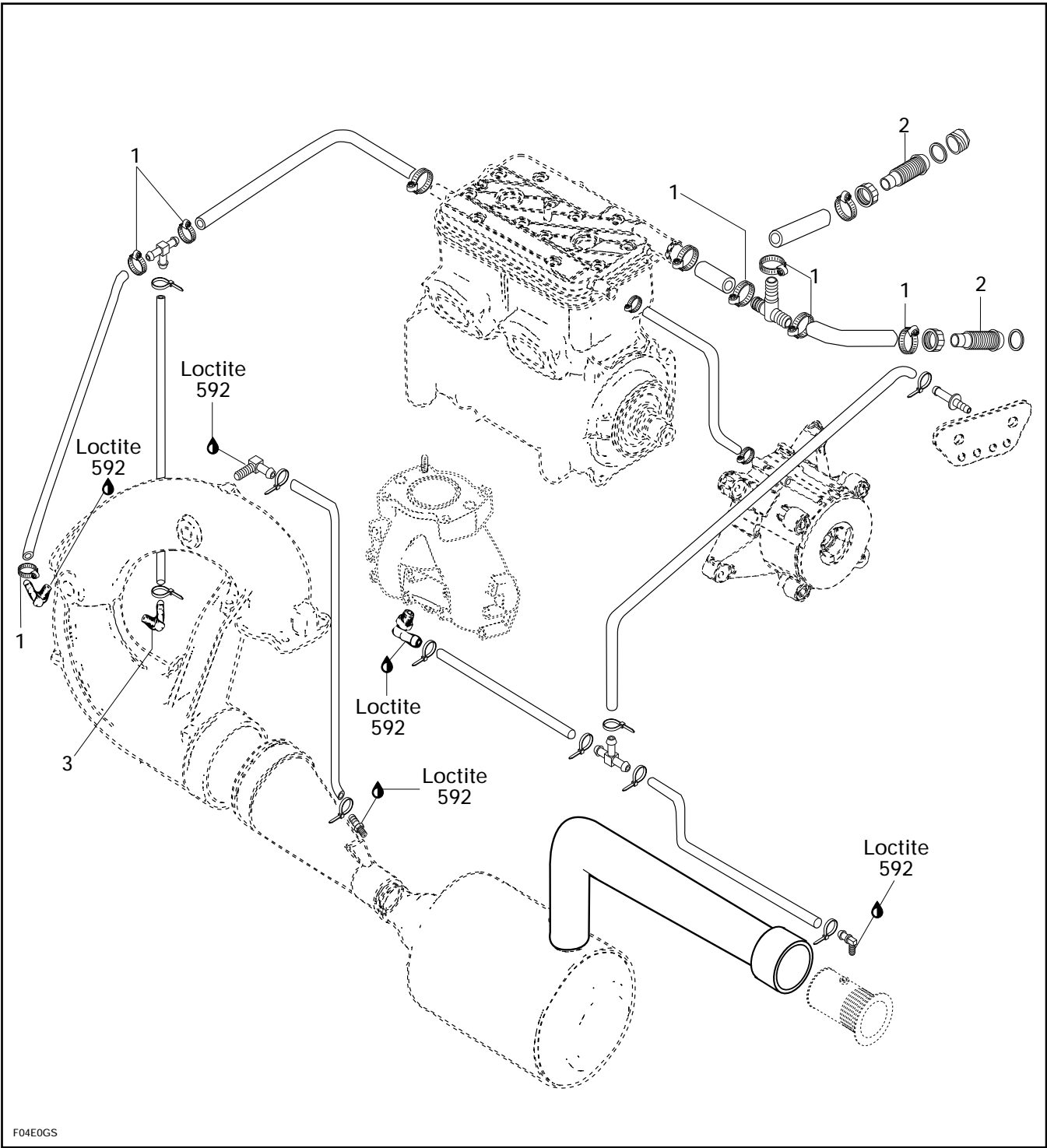
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COMPONENTS

Sportster and Speedster



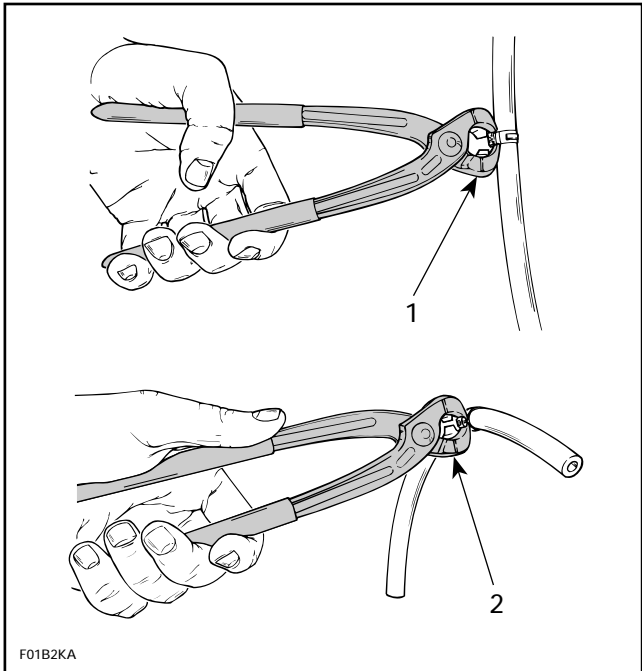
GENERAL

All Models

CAUTION : All hoses and fittings of the cooling system have calibrated inside diameters to assure proper cooling of the engine. Always replace using appropriate Bombardier part number.

1, Clamp

To cut or secure non-reusable Oetiker clamps of cooling system hoses, use pliers (P / N 295 000 070).



- 1. Cutting clamp
- 2. Securing clamp

2, Flushing Connector

The flushing connector is used to flush cooling system. Refer to MAINTENANCE 02-02.

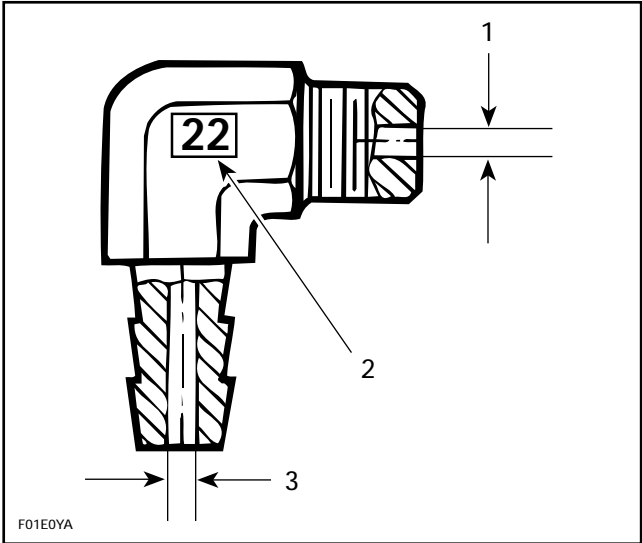
3, Elbow Fitting

Water injection used on exhaust system cools the exhaust gases to obtain maximum performance from the tuned pipe. The elbow fitting has a calibrated inside diameter to optimize water flow.

The water injection also helps in reducing noise level and cools components of the exhaust system.

CAUTION : The elbow fittings are calibrated for each engine model and can not be interchanged with one of a different size as severe engine damage could result.

The elbow fitting can be identified by using the 2 digits number stamped onto the fitting or by measuring its inside diameter. Refer to the following illustration and chart.



TYPICAL

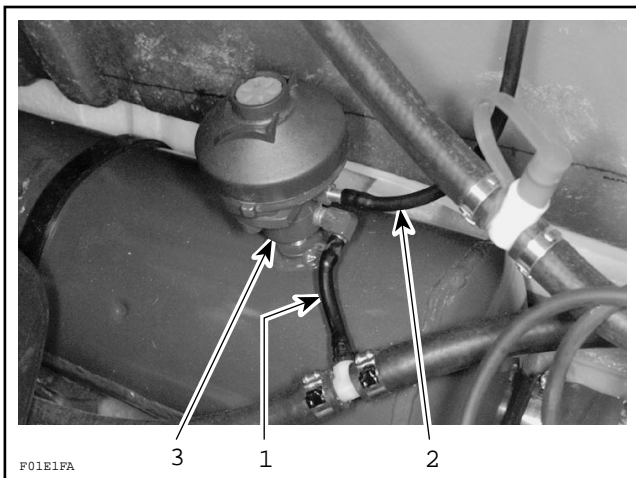
- 1. Outlet diameter
- 2. Stamped number
- 3. Inlet diameter

Stamped Number On Fitting	Fitting P / N	Inlet Diameter	Oulet Diameter
22	293 700 022	5.5 mm (.219 in)	4.6 mm (.181 in)
24	293 700 024	5.5 mm (.219 in)	3.5 mm (.139 in)
48	293 710 048	4.0 mm (.157 in)	3.5 mm (.139 in)

Challenger

A water flow regulator valve has been developed so that the engine can produce the maximum horsepower output and yet maintain the necessary diameter of the injection fitting at the tuned pipe head for unobstructed water flow.

The water flow regulator valve is mounted directly onto the resonator.



1. Water supply hose of regulator valve
2. Regulated water to injection fitting at tuned pipe head
3. Water injected into the resonator

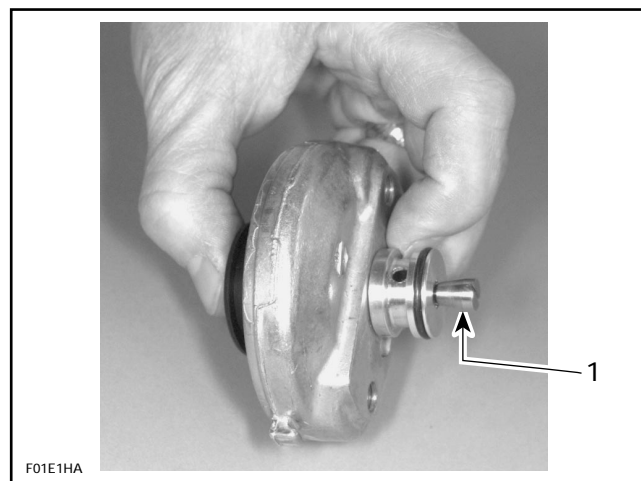
NOTE : The water injected into the resonator is not regulated by the valve. A calibrated water injection fitting of 3.0 mm (.118 in) inside diameter limits water flow into the resonator.

WATER FLOW REGULATOR VALVE

The water flow regulator valve has a calibrated spring and a tapered needle which regulate the injected water in the tuned pipe.

CAUTION : Do not change the calibration of the spring, otherwise serious engine damage can occur.

At low speed, water pressure in the supply hose of the regulator valve is not sufficient to overcome the spring of the regulator valve ; more water is being delivered to the injection fitting at the tuned pipe.



1. Needle position at low speed

At higher speed, water pressure increases in the supply hose of the regulator valve and gradually overcomes the return spring of the regulator valve. Less water is being delivered to the injection fitting at the tuned pipe.



1. Needle position at high speed

Section 05 COOLING SYSTEM

Sub-Section 01 (COMPONENTS)

ADJUSTEMENT

○ **NOTE** : The water flow regulator valve has been calibrated at the factory and should not be tampered with or modified in any way.

▼ **CAUTION** : Strictly adhere to the calibration procedure below, otherwise serious engine damage can occur.

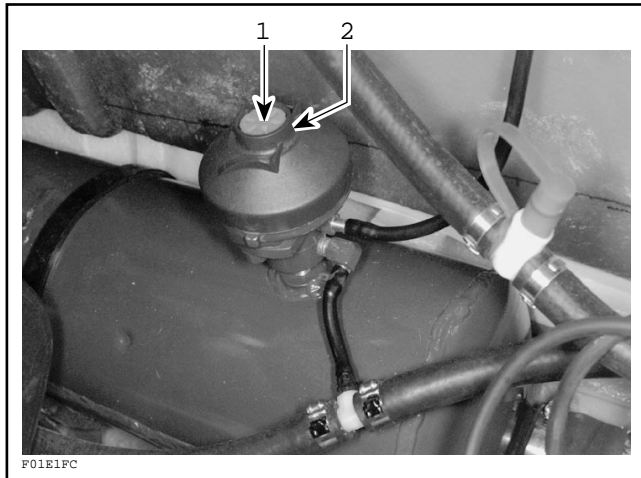
If engine does not attain its maximum RPM or your customer is experiencing poor performance, the water flow regulator valve might be out of adjustment.

The nominal adjustment as done at the factory is as follows :

On the top of the water flow regulator valve locate the red plastic adjustment screw.

Mark the location of the screw with a dab of paint for reference purposes.

Turn the screw clockwise (tighten) until the top edge of the screw is flush with the top of the black valve cap.



1. Turn this screw
2. Black valve cap

Turn the screw **2 clicks** counterclockwise (loosen).

The verification is now complete.

CIRCUIT

GENERAL

TECHNICAL DATA
TYPE : TLCS (Total Loss Cooling System).
COOLANT FLOW : Pressure build-up at impeller housing (no water pump).
TEMPERATURE CONTROL : Calibrated outlet fittings (no thermostat).
SYSTEM BLEEDING : Self-bleed type (hose at uppermost point of circuit and at tuned pipe).
SYSTEM DRAINING : Self-drain type (hose at lowest point of circuit).
SYSTEM FLUSHING : Flushing connector on boat transom and in engine compartment area.
MONITORING BEEPER : Turns on at 96-99°C (205-210°F).

The cooling system is equipped with flushing connectors for flushing purposes.

For flushing operation, a garden hose is to be connected to flush the whole system by backwash. For flushing procedure, refer to MAINTENANCE 02-02.

For winterization of cooling system, refer to MAINTENANCE 02-04.

The cooling system is made up of the following major items : jet pump, engine top end, tuned pipe, exhaust manifold, engine cylinders and a water flow regulator valve on **Challenger only**.

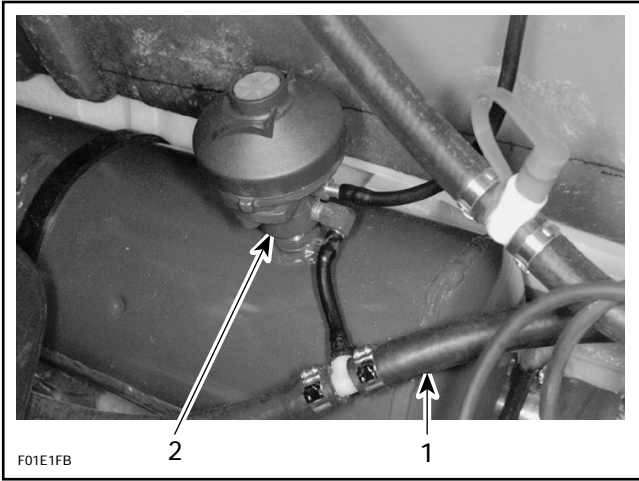
The water supply is taken from a pressurized area in the jet pump between the impeller and venturi.

The tuned pipe and exhaust manifold are designed with a double wall to allow water circulation.

Challenger Only

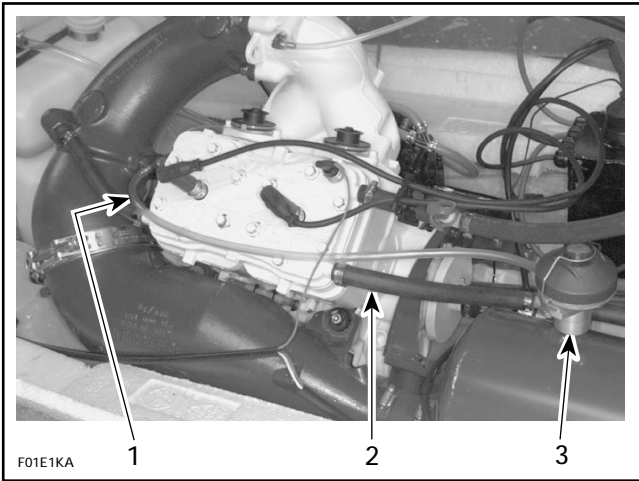
Prior to entering the engine, the main inlet hose from the jet pump has a T-fitting to supply the water

flow regulator valve which is mounted directly on the muffler. This mounting position provides immediate cooling for the muffler.



- 1. Engine water supply hose
- 2. Water injected directly into the muffler

The remaining outlet from the water flow regulator valve supplies the water injection fitting at the tuned pipe head with a predetermined volume of water throughout the engine RPM range.



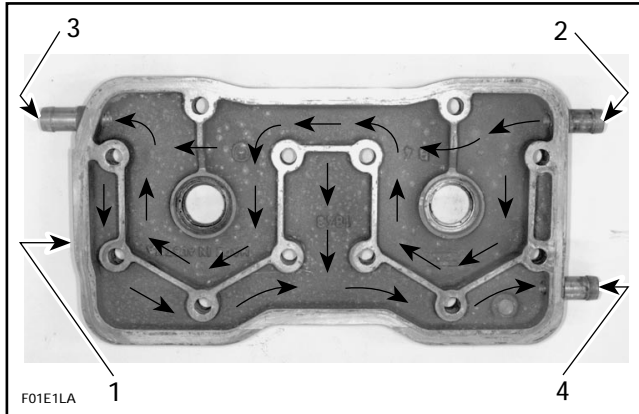
- 1. Regulated water to injection fitting
- 2. Fresh water entering head assembly
- 3. Water flow regulator valve

Section 05 COOLING SYSTEM

Sub-Section 02 (CIRCUIT)

All Models

Fresh water from the jet pump enters the head assembly, cooling the combustion chamber to prevent detonation.



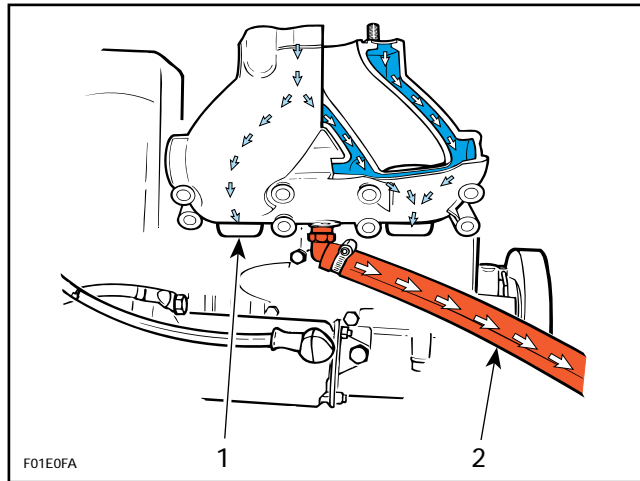
1. Cylinder head cover
2. Fresh water from jet pump
3. Water exiting head assembly to tuned pipe, exhaust manifold and cylinders
4. Water from cylinder water jackets exiting engine

On Sportster / Speedster, water flows out of cylinder head toward tuned pipe water jackets. A T-fitting on the hose allows water to be injected with the exhaust gases.

On Challenger, water flows out of cylinder head toward tuned pipe water jackets. The water to be injected with the exhaust gases is controlled by the water flow regulator valve as explained previously.

All Models

Water injected through the exhaust gases continues to flow out through the exhaust outlet. Water in the tuned pipe water jackets continues to flow through the exhaust manifold water jackets toward the engine cylinder water jackets via passages below exhaust ports.

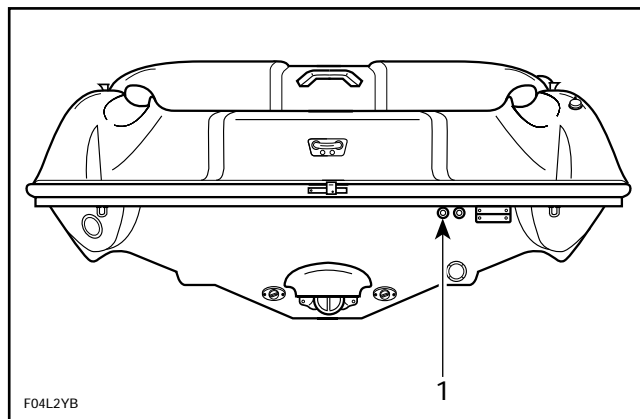


TYPICAL - SPORTSTER / SPEEDSTER

1. Water enters cylinder cooling jacket
2. Drain hose

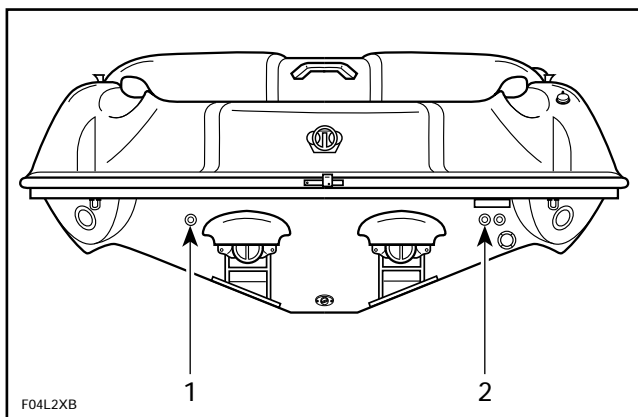
The water continues to the engine cylinder head and then goes out through the outlet fitting there. No water enters crankcase.

For a minimum of back pressure in the exhaust, engine water outlet hose is not connected to the exhaust. It has its own fitting at the transom (the same used for flushing the cooling system).



TYPICAL - SPORTSTER / CHALLENGER

1. Engine water outlet

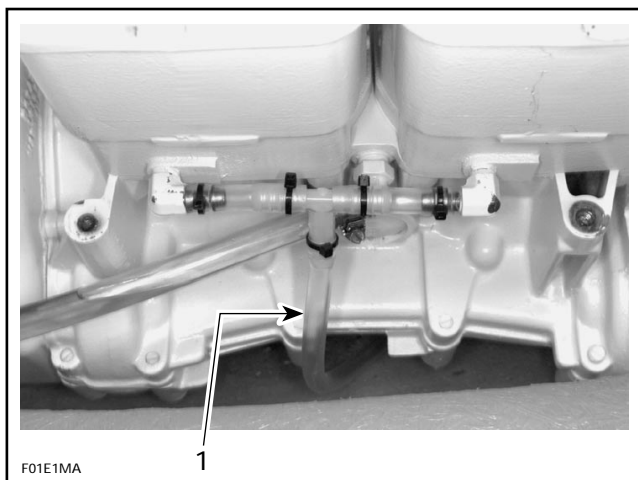


SPEEDSTER

1. Port engine water outlet
2. Starboard engine water outlet

On Sportster / Speedster, draining of the system is accomplished by a fitting to the bottom of exhaust manifold. Refer to illustration above.

On Challenger, draining of the system is accomplished by a fitting at the bottom of each cylinder. Fittings are linked to a common line. The line is connected to the exhaust outlet at the stern of the craft.



CHALLENGER

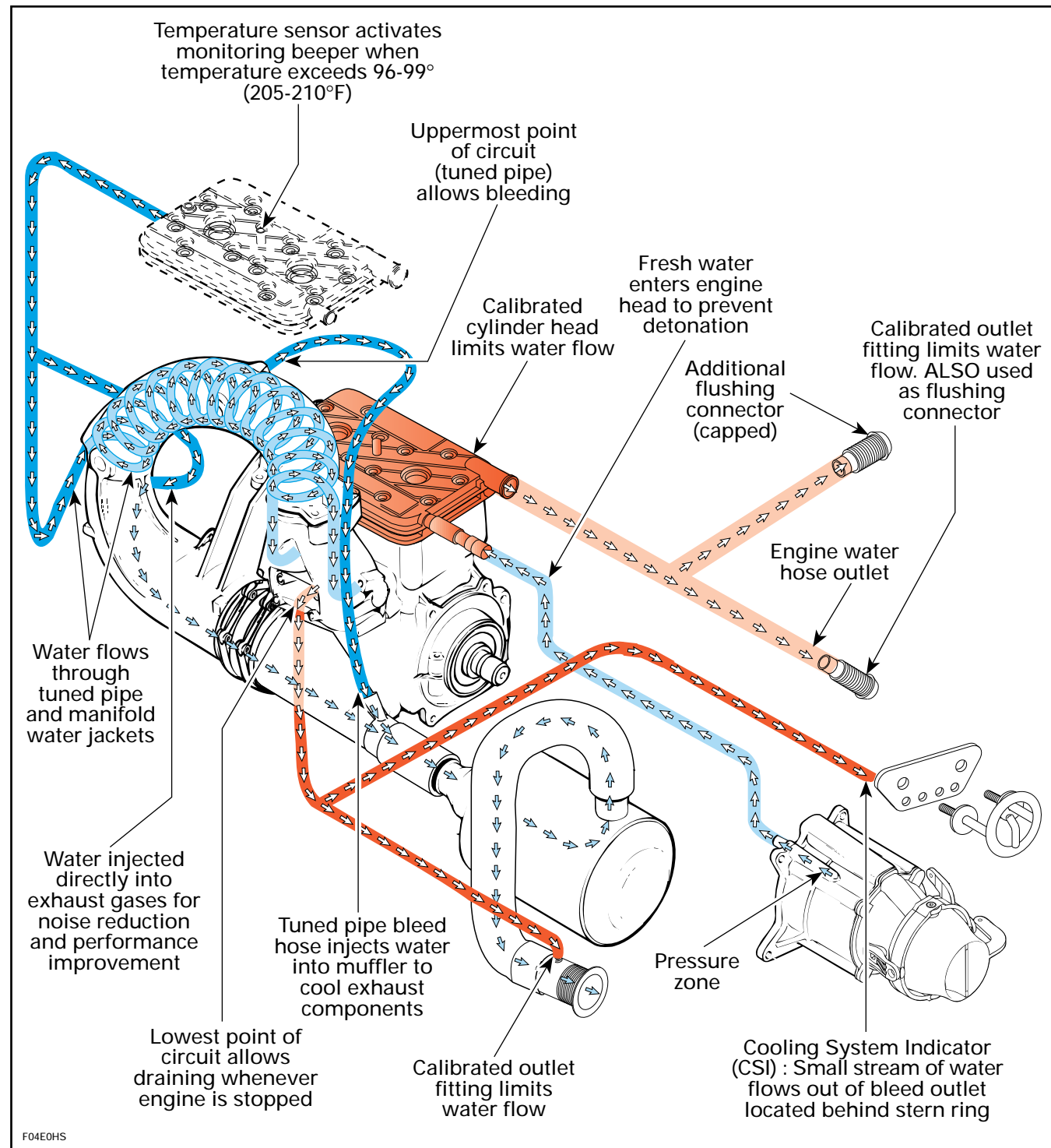
1. Drain hose

For a complete view of cooling system arrangement, refer to the next pages.

▼ **CAUTION** : Never modify cooling system arrangement, otherwise serious engine damage could occur.

Section 05 COOLING SYSTEM
Sub-Section 02 (CIRCUIT)

717 Engine Cooling System



TYPICAL - SPORTSTER AND SPEEDSTER

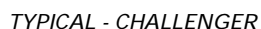
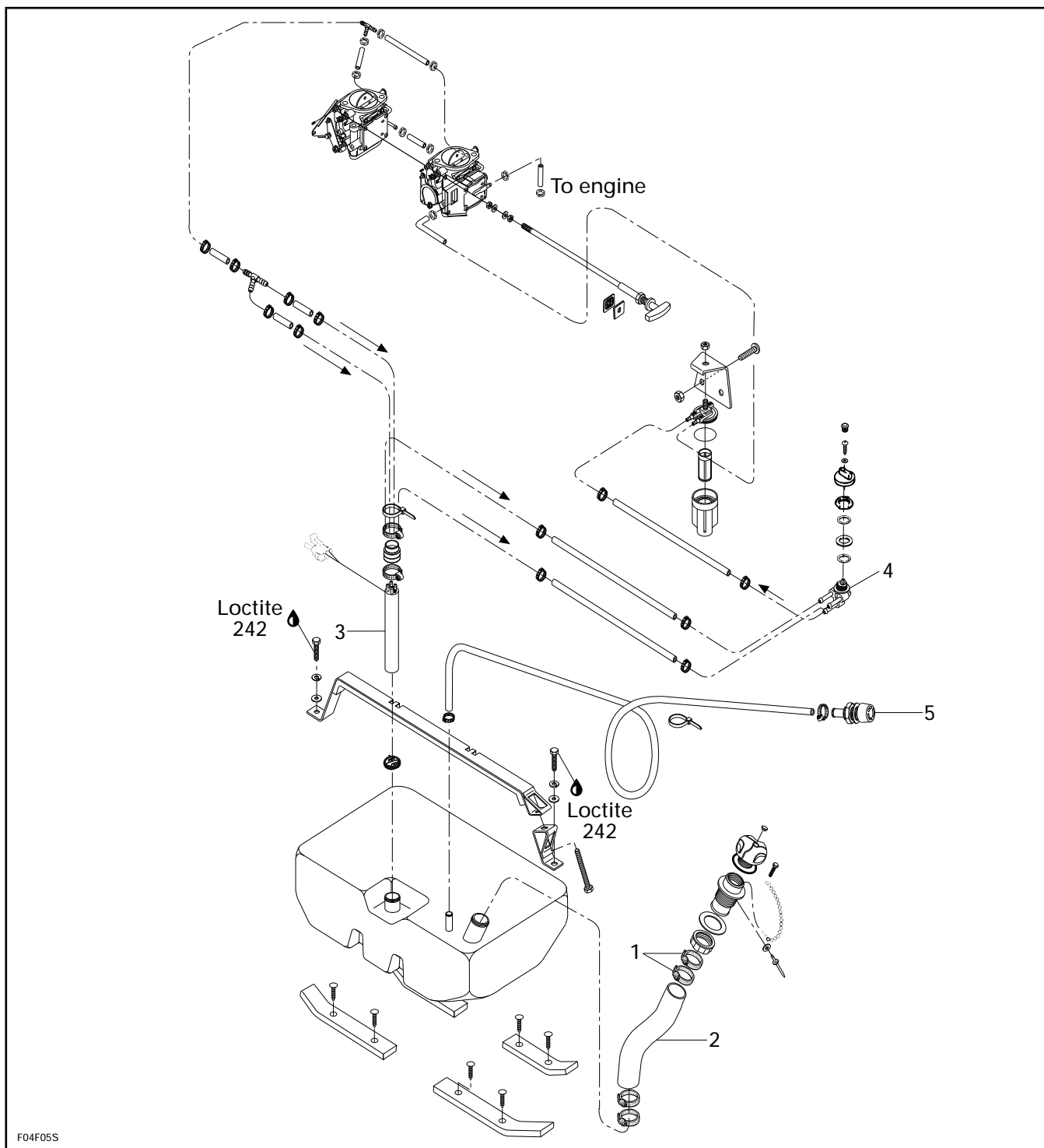


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FUEL CIRCUIT

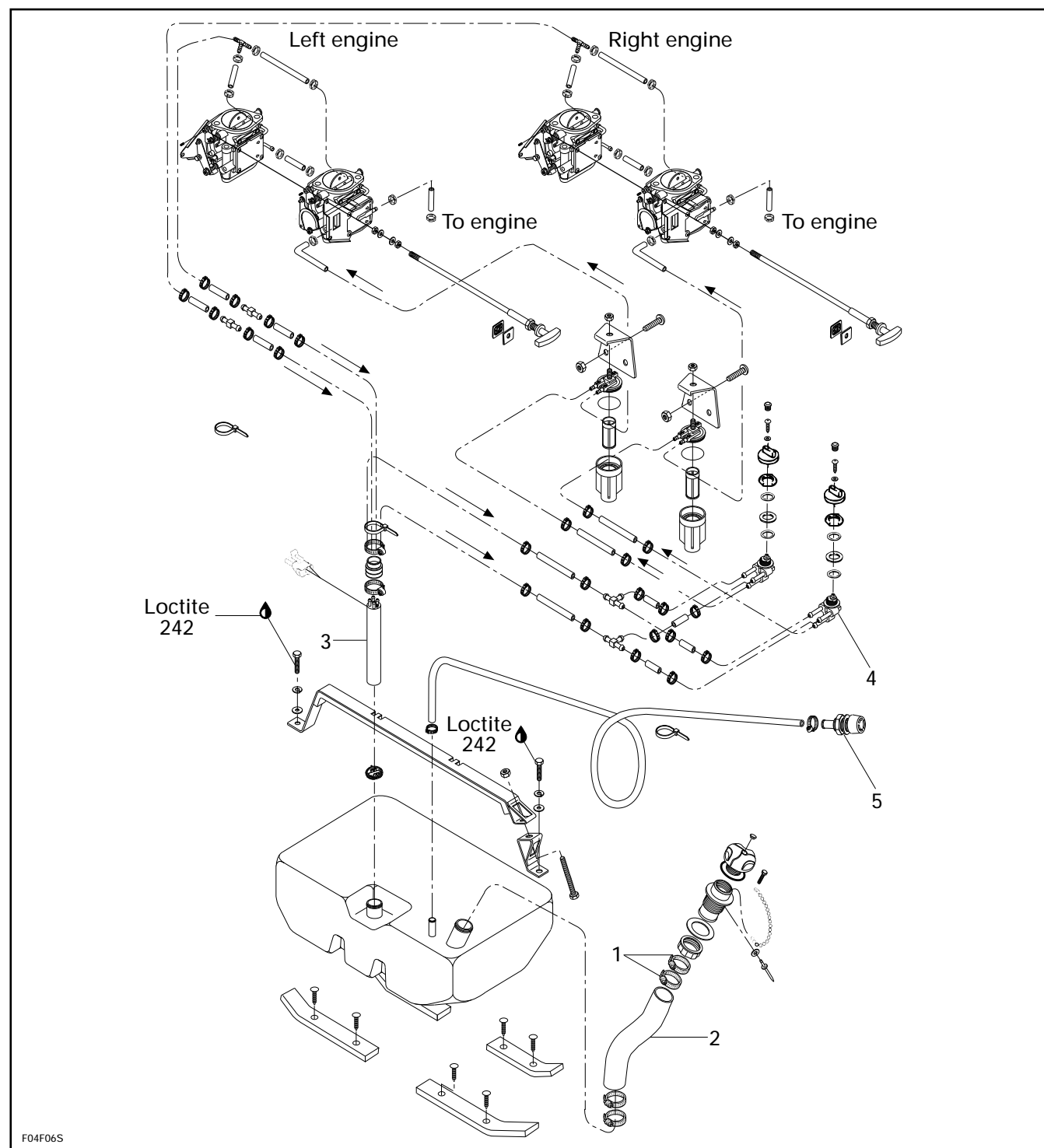
Sportster and Challenger



F04F05S

Section 06 FUEL SYSTEM
Sub-Section 01 (FUEL CIRCUIT)

Speedster



GENERAL

Whenever repairing the fuel system, always verify for water infiltration in reservoir.

When replacing fuel lines on SEA-DOO JET BOATS be sure to use «B1» hoses as available from the BOMBARDIER parts department. This will ensure continued proper and safe operation.

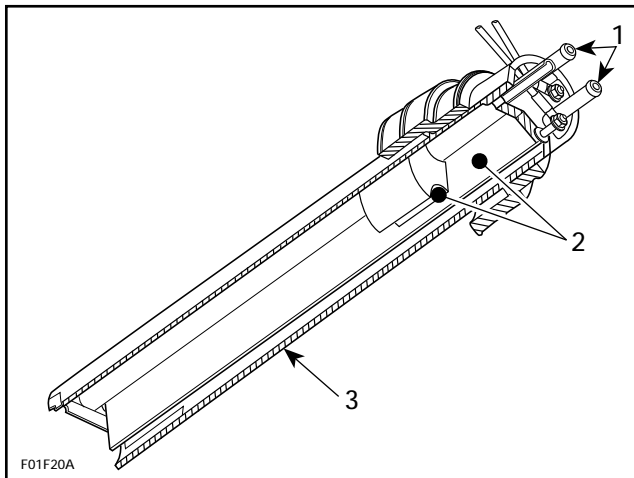
◆ **WARNING :** Use of improper fuel lines could compromise fuel system integrity. Whenever repairing the fuel system always pressure test.

1,2, Gear Clamp and Filler Neck Hose

Verify fuel filler neck hose for damage. Always ensure that clamps are well positioned and tightened. Torque clamps to 4.5 N•m (40 lbf•in).

3, Baffle Pick Up

○ **NOTE :** The baffle pick up has an integrated fuel sensor.



- 1. Pick-up tube
- 2. Fuel sensor
- 3. Baffle pick-up

Disconnect BLACK negative cable, then RED positive cable of battery.

◆ **WARNING :** Always disconnect battery cables exactly in the specified order, BLACK negative cable first. Electrolyte or fuel vapors can be present in the engine compartment and a spark might ignite them and possibly cause personal injuries.

Empty fuel tank.

◆ **WARNING :** Fuel is inflammable and explosive under certain conditions. Always work in a well ventilated area. Do not smoke or allow open flames or sparks in the vicinity. Always wipe off any fuel spillage from the boat.

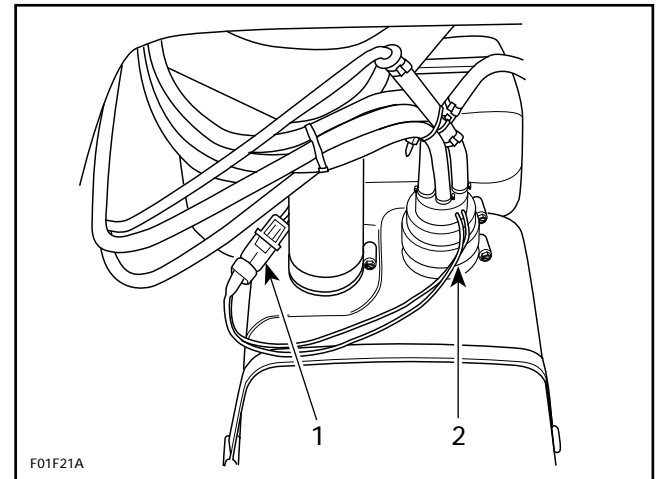
Challenger Only

Remove ski post braces and fuel filter bracket.

All Models

Remove hoses from baffle pick up and disconnect fuel sensor wiring harness.

Remove lower clamp from baffle pick up adapter and pull out baffle from fuel tank.



TYPICAL

- 1. Wiring harness
- 2. Baffle pick up adapter

Remove upper clamp from adapter and slide adapter from baffle.

○ **NOTE :** Assembly is essentially the reverse of disassembly procedures.

Slide adapter onto baffle pick up until it stops on rib. Install clamp.

Install baffle pick up into fuel tank and push it until it sits on fuel tank neck. Install clamp and torque both clamps to 3 N•m (27 lbf•in).

4,5, Fuel Valve and Fuel Tank Vent

To reach fuel valve, fuel lines and fuel tank air vent line, remove throttle/psifter control to gain access.

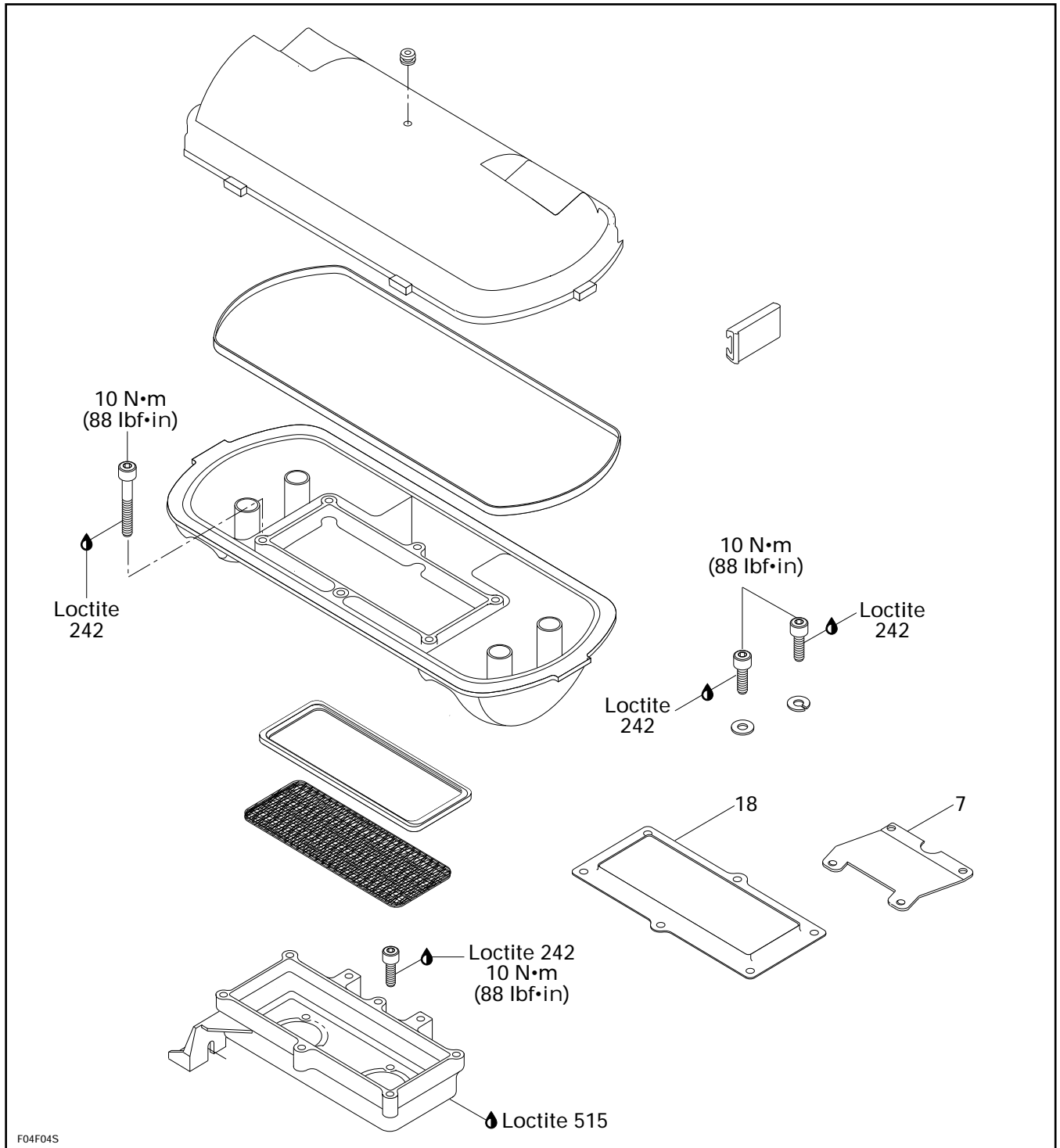
○ **NOTE :** Sportster and Challenger only, vent line fitting can be reached from engine compartment.

Fuel Tank Removal

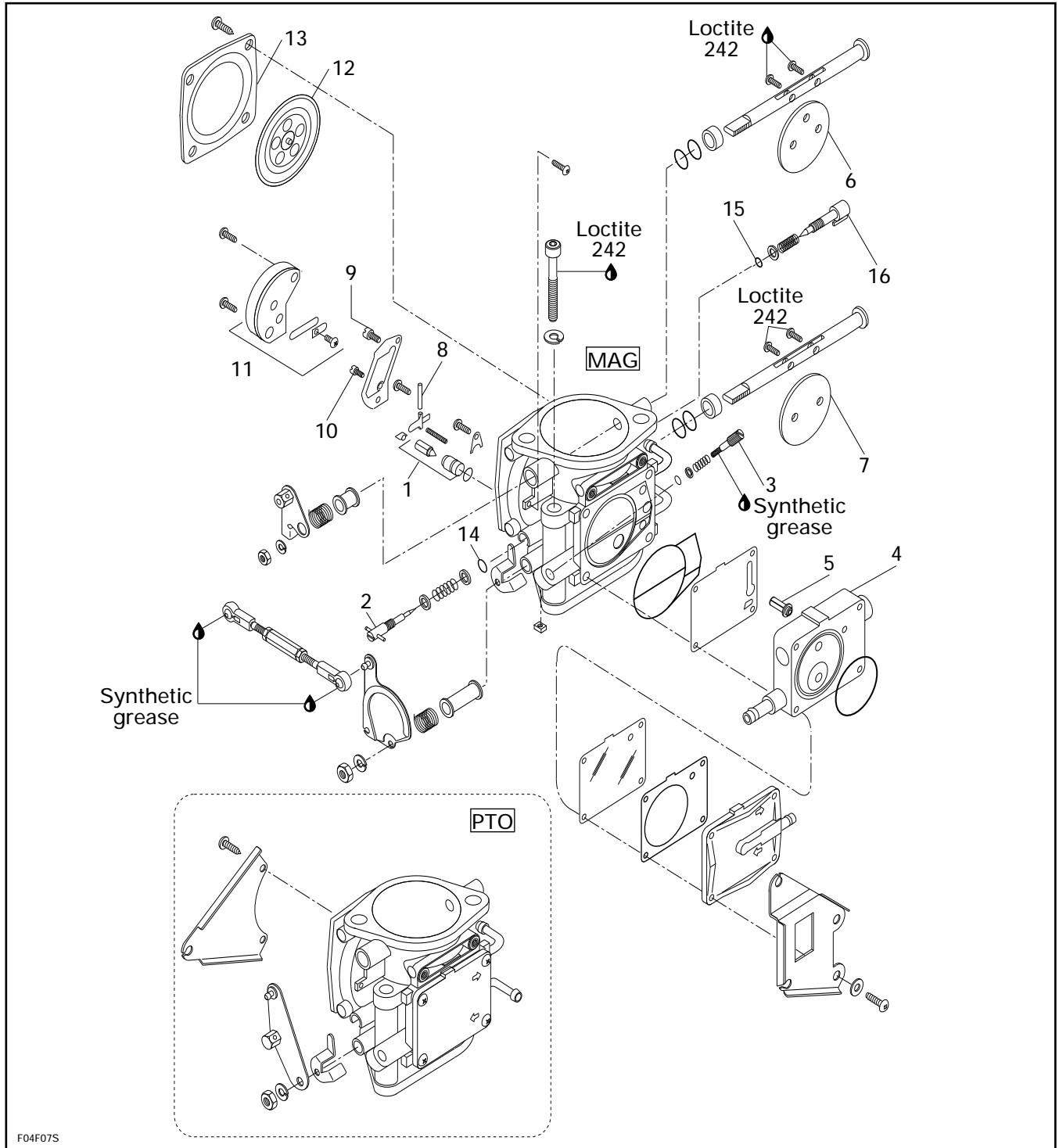
Remove the following parts to allow fuel tank removal :

- jet pump(s)
- engine(s)
- electrical box (**Speedster** only)
- battery and its case (when applicable)

AIR INTAKE



CARBURETORS



F04F07S

GENERAL

Some carburetor components and / or settings can be changed to improve boat performance in high altitude regions between 1500-3000 m (5000-10000 ft).

Refer to the service department for the latest specifications.

▼ **CAUTION :** Such modifications should only be performed by experience mechanics since they can greatly affect boat performance.

CARBURETOR REMOVAL

To remove carburetors from engine, proceed as follows :

Intake and Fuel Systems

Unlock retaining slides holding air intake silencer cover and remove cover.

Remove screws holding retainer and air intake silencer base. Remove air intake silencer base from jet boat.

Remove screws holding flame arrester base support to cylinder head cover.

Unscrew base retaining screws then remove base from carburetors and move it to front of jet boat.

Turn fuel valve(s) to OFF position.

○ **NOTE :** For fuel line removal, use pliers (P / N 295 000 054).

Disconnect pulse line from fuel pump.

Disconnect fuel supply line from fuel pump.

Disconnect fuel return line.

Disconnect oil injection pump cable, throttle cable and choke cable.

Remove screws and lock washers retaining carburetors.

Remove linkage rod from carburetors.

Remove carburetors from intake manifold.

CLEANING

The entire carburetor should be cleaned with a general solvent and dried with compressed air before disassembly.

▼ **CAUTION :** Be careful at carburetor cleaning not to remove paint. Paint removal will cause carburetor to rust very rapidly. Repaint if necessary.

Carburetor body and jets should be cleaned in a carburetor cleaner following manufacturer's instruction.

◆ **WARNING :** Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

◆ **WARNING :** Heavy duty carburetor cleaner may be harmful to the rubber parts, O-ring, etc. Therefore, it is recommended to remove those parts prior to cleaning.

Discard O-rings, diaphragms and gaskets.

DISASSEMBLY AND INSPECTION

Inspect parts for corrosion damage (shaft, butterfly, spring, screw, check valve housing, etc.).

1, Needle Valve

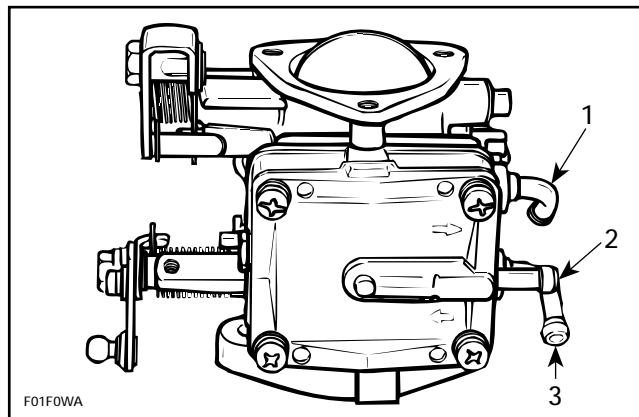
Inspect needle valve tip for a grooved condition. If worn, needle and seat must be replaced as a matched set.

2, Low Speed Mixture Screw

Check tip for a grooved condition. Replace if necessary.

PUMP VERIFICATION

Plug carburetor inlet nipple.



TYPICAL

1. Fuel outlet nipple
2. Pulse nipple
3. Plug inlet nipple

Check fuel pump valves operation as follows :

Connect a clean plastic tubing to the inlet nipple and alternately apply pressure and vacuum with the mouth. The inlet valve should release with pressure and hold under vacuum.

Repeat the same procedure at the outlet nipple. This time the outlet valve should hold with pressure and release under vacuum.

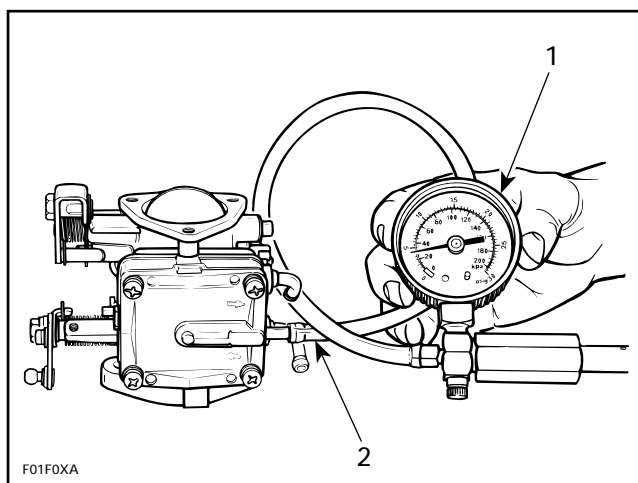
◆ **WARNING :** Some fuel may be present in fuel pump. Be careful not to swallow fuel when under vacuum.

3, Diaphragm

Pump Diaphragm Leak Test

Using a suitable pump gauge tester, perform the following test proceeding as follows :

- Install pump gauge tester (P / N 295 000 083) on pulse nipple.
- Pump tester until it reaches 28 kPa (4 PSI).



TYPICAL

1. Pump gauge tester
2. Install on pulse nipple

Diaphragm must stand pressure for 10 seconds. If pressure drops, replace diaphragm.

4, Pump Body

Inspect valves. The pumping area should be free of holes, tears or imperfections. Replace as needed.

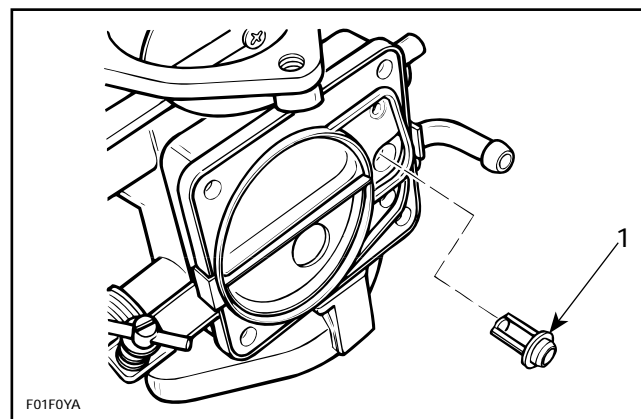
5, Filter

To verify filter condition proceed as follows:

Remove pump cover, gasket, diaphragm and then pump body and gasket.

Remove filter from carburetor body then clean filter and blow carefully with compressed air (low pressure).

Replace filter if damaged.



TYPICAL

1. Filter

CARBURETOR ASSEMBLY

When assembling pump, ensure to properly position components together. Refer to previous illustrations if necessary.

6,7, Choke Plate and Throttle Plate

When installing butterfly onto shaft, close butterfly so that it centers into carburetor bore. Firmly tighten screws.

▼ **CAUTION :** Always apply Loctite 242 (blue) on screw threads prior to installing screws.

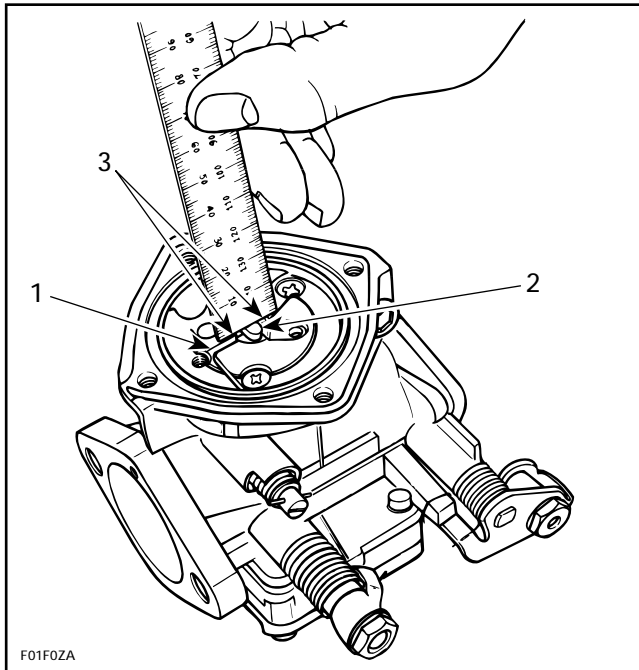
8, Needle Valve Lever

Inlet Control Lever

Rounded end of needle valve lever must be flush with surrounding metering chamber floor and not with body assembly. Place the end of a ruler over lever to check adjustment.

Section 06 FUEL SYSTEM

Sub-Section 03 (CARBURETORS)

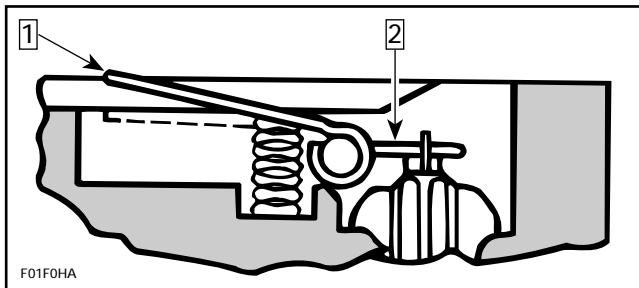


TYPICAL

1. Metering chamber floor
2. Lever end
3. Flush

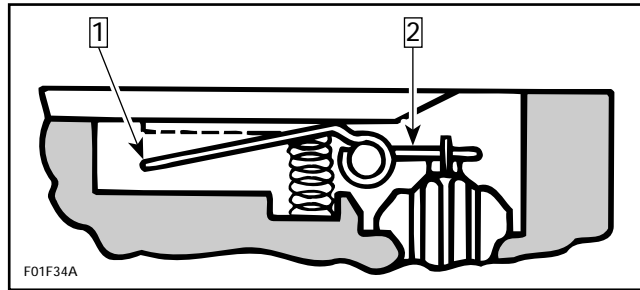
To adjust, bend lever very slightly to change its height.

▼ **CAUTION** : When adjusting lever, do not pry it so that it applies pressure on needle. This could damage valve seat / needle.



HIGH LEVER

- Step 1 : Depress here
- Step 2 : Push tab down



LOW LEVER

- Step 1 : Depress here
- Step 2 : Pry up here

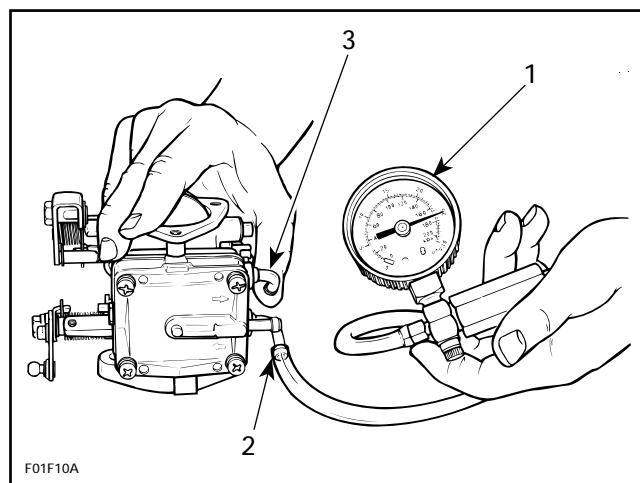
Pressure Test

Proceed as follows :

- Install pump gauge tester on carburetor inlet nipple.
- Obstruct outlet nipple with a finger.
- Pump tester until inlet release pressure is reached (seen by a sudden pressure drop). This must occur within 280-392 kPa (40-56 PSI). On **Sportster** and **Speedster** and within 189-273 kPa (27-39 PSI) on **Challenger**.

The pressure drop will vary, but it should not go less than 83 kPa (12 PSI).

○ **NOTE** : Pressure test should be performed 3 times to obtain a valid reading.



TYPICAL

1. Pump gauge tester
2. Install on inlet nipple
3. Obstruct outlet nipple

If release pressure is not within specification, check control lever adjustment. Replace spring as necessary.

▼ **CAUTION** : Do not stretch or cut spring.

Leak Test

Needle valve must stand a pressure of 69 kPa (10 PSI) for 30 seconds. Otherwise, hold carburetor upside down, pour oil over needle valve and apply pressure.

Check for bubbles. If they come from seat O-ring, bubbles will exit around seat. Retighten as necessary.

If it still leaks remove needle and seat and replace O-ring.

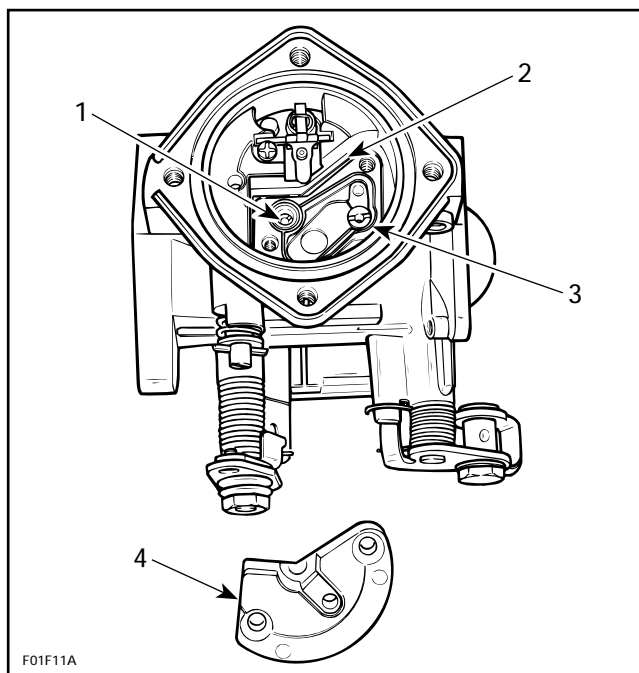
If bubbles come from needle, replace needle and seat.

9,10, Main Jet and Pilot Jet

Pilot jet and main jet are replaceable. Different jet sizes are available to suit temperature and altitude conditions. Always inspect spark plug tip condition when dealing with pilot jet and main jet. Spark plug tip condition gives a good indication of carburetor mixture setting.

CAUTION : Adjustments vary with temperature and altitude. Always observe spark plug condition for proper jetting.

NOTE : To have access to pilot jet or main jet, check valve housing must be removed.



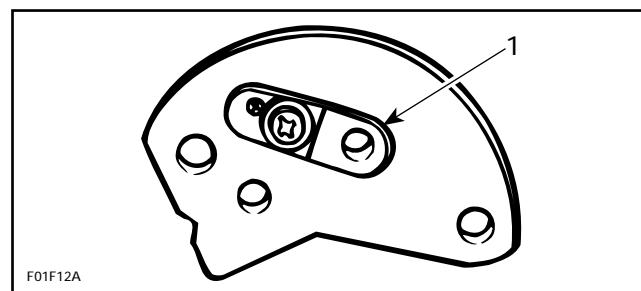
TYPICAL

1. Pilot jet
2. Gasket
3. Main jet
4. Check valve housing

11, Check Valve Assembly

The check valve is needed if a back pressure occurs into carburetor. It will prevent fuel from flowing back into carburetor lower portion.

Inspect check valve, it should be free of holes, tears or imperfections. Replace as needed.



1. Check valve

NOTE : Prior to check valve assembly installation, remember to set gasket.

12,13, Diaphragm and Cover

Install diaphragm with its integrated O-ring into carburetor groove. Make sure that the tab of cover is inserted into carburetor notch.

14,15, O-ring

When installing O-rings of low speed and high speed screws, apply some BOMBARDIER LUBE (P / N 293 600 006) to prevent sticking.

CARBURETOR INSTALLATION

At installation, pay attention to the following :

Install carburetors with gaskets to intake manifold.

Synchronize carburetor before installation. Refer to Carburetor Synchronization.

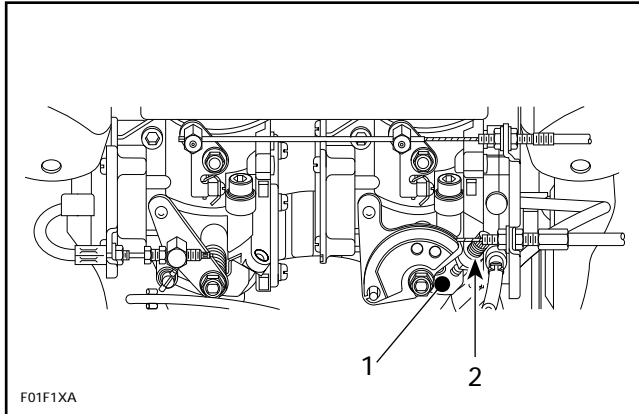
Apply Loctite 242 (blue) on screw threads. Then, install screws with lock washers and torque to 20 N•m (15 lbf•ft).

Section 06 FUEL SYSTEM

Sub-Section 03 (CARBURETORS)

Carburetor Synchronization

With idle speed screw not touching throttle lever stopper on MAG carburetor, both throttle plates are in closed position.

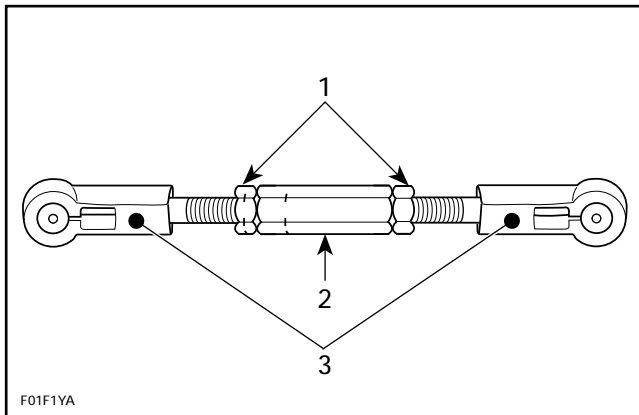


717 ENGINE SHOWN

1. Stopper
2. Idle speed screw

Loosen jam nuts on carburetor linkage and adjust linkage with adjustment nut.

Make sure threads length is the same on each side of linkage and flat surfaces of both ends are parallel with each other.



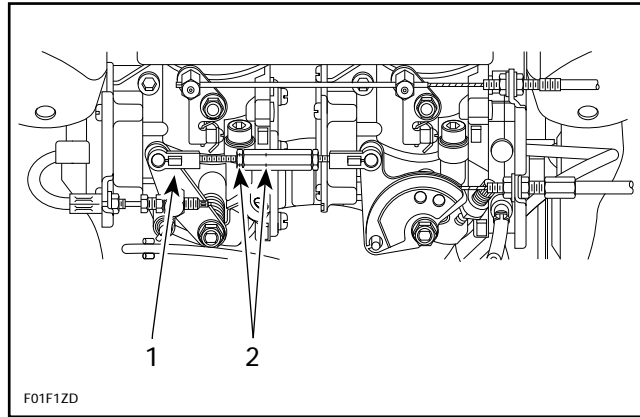
1. Jam nuts
2. Adjustment nut
3. Flat surfaces

Tighten jam nuts and torque to 3 N•m (27 lbf•in).

NOTE : Grease carburetor linkage at both ends with synthetic grease (P / N 293 550 010).

Connect linkage between both carburetor levers. Ensure both throttle plates are still in closed position.

NOTE : The linkage installation is done with the marks located near PTO carburetor throttle lever to ease adjustment if to be performed in the boat.



717 ENGINE SHOWN

1. Throttle lever PTO side
2. Marks

CAUTION : Throttle plates must open simultaneously, otherwise this will cause engine to vibrate and / or back fire.

Turn idle speed screw until it contacts throttle lever stopper. Then, turn 2 additional turns.

Fuel Lines and Hose Clamps

If fuel line ends are damaged, cut damaged end before reinstallation.

Properly tighten clamps with pliers (P / N 295 000 054).

WARNING : Make sure there is no leak in fuel system.

Refer to Fuel System Pressurization.

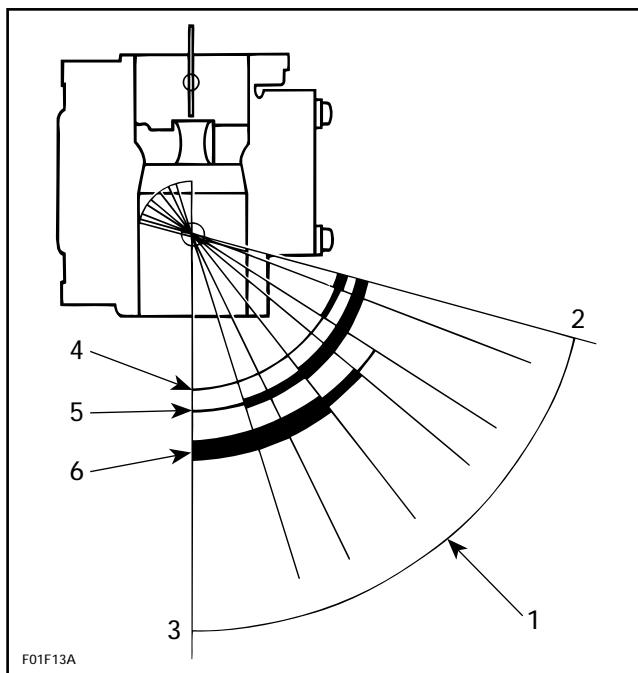
Flame Arrester

Always verify if flame arrester is dirty or restricted.

WARNING : Never operate boat without flame arrester.

ADJUSTMENTS

The following illustration shows which part of the carburetor begins to function at different throttle valve openings.



VIEW FROM AIR INTAKE OPENING

1. Throttle plate openings
2. Close
3. Wide open
4. Low-speed screw
5. Pilot jet
6. Main jet and high-speed screw

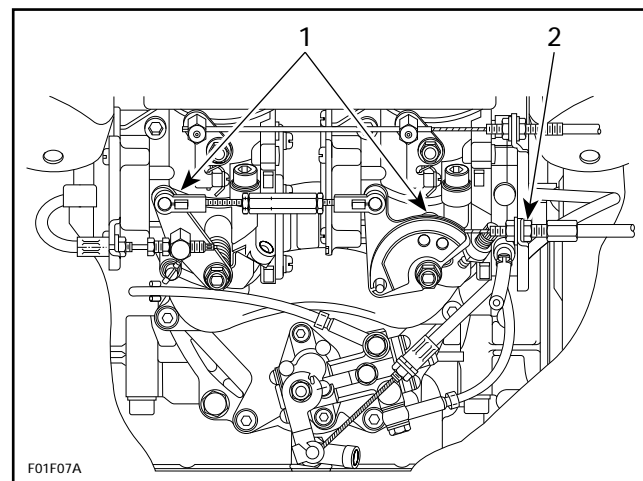
Throttle Cable(s)

▼ **CAUTION** : Make sure engine is turned off before adjusting throttle cable(s).

Lubricate cable(s) with BOMBARDIER LUBE lubricant.

Fully push throttle lever(s). Validate that there is no strain in cable or in carburetor cable bracket.

Ensure carburetor butterflies are fully open at full throttle position. At this position, throttle stop lever will almost contact carburetor body (0.4 mm (1/64 in)).



717 ENGINE SHOWN

1. Throttle lever stoppers (behind levers)
2. Adjustment nut

Speedster Only

Ensure that at full throttle, both throttle levers (operator's control) are synchronized at the same position.

All Models

▼ **CAUTION** : Improper cable adjustment will cause strain on cable and / or damage cable support or throttle lever at carburetor.

To adjust, loosen jam nut ; turn adjustment nut as necessary.

Tighten jam nut and recheck adjustment.

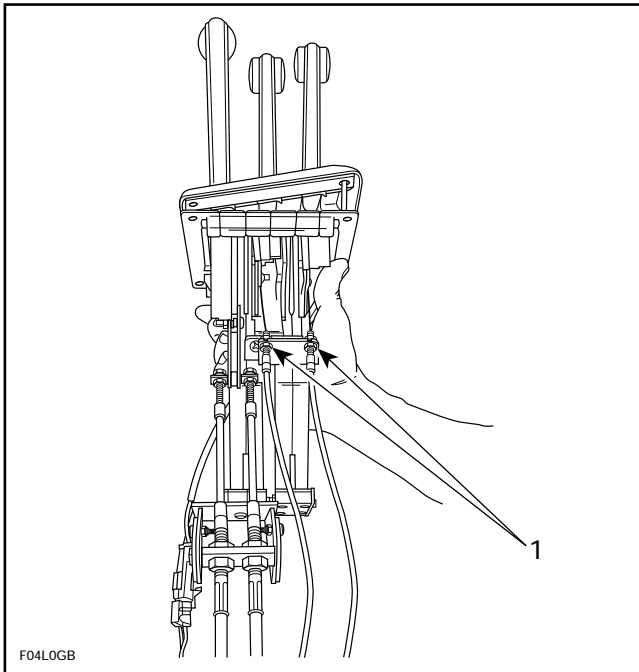
If more adjustment is required than carburetor cable adjuster can provide, adjust cable at throttle / shifter control. Ensure that cable housing end does not touch throttle lever cam when moving it.

Unscrew throttle / shifter control from boat.

▼ **CAUTION** : Use a protective mat in throttle shifter area when withdrawing it for adjustment.

Section 06 FUEL SYSTEM

Sub-Section 03 (CARBURETORS)



TYPICAL-SPEEDSTER SHOWN

1. Throttle cable adjustments

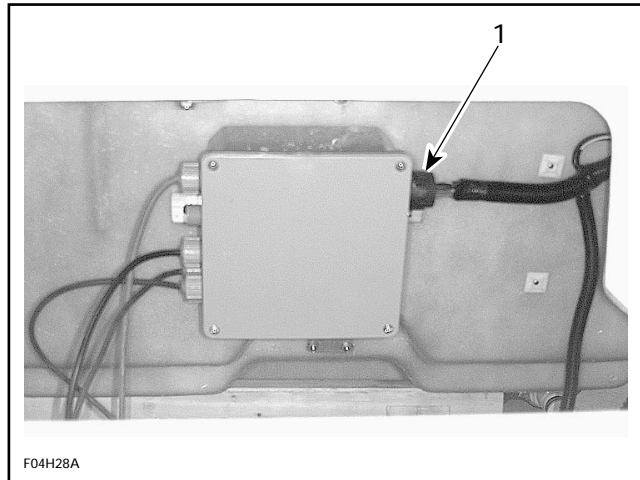
◆ **WARNING :** Make sure idle speed screw contacts stopper when throttle lever is fully pulled back at throttle lever control.

After throttle cable adjustment, always proceed with oil injection pump adjustment.

▼ **CAUTION :** Improper oil injection pump synchronization with carburetor can cause serious engine damage.

Reconnect battery (ies) cables.

◆ **WARNING :** To prevent any possible spark that may occur at the battery terminals while connecting the cables, unscrew and disconnect the connector at the electrical box PRIOR TO CONNECTING THE BATTERY CABLES.

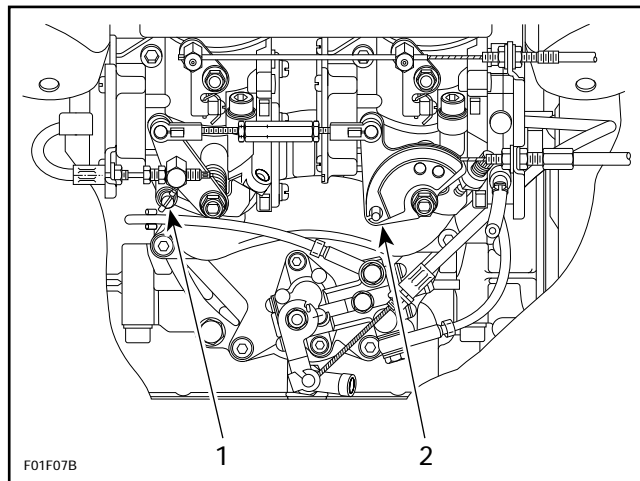


1. Electrical box connector

◆ **WARNING :** Always connect RED positive cable first then BLACK negative cable last.

After connecting the battery, reinstall the electrical box connector.

2, Low-Speed Mixture Screw



717 ENGINE SHOWN

1. PTO low speed screw

2. MAG low speed screw (not shown)

▼ **CAUTION :** Do not attempt to set engine idle speed with low-speed mixture screw. Severe engine damage can occur.

As a preliminary set-up, tighten screw in until a slight resistance is felt then back off 1-1/4 turn on Sportster and Speedster and 1 turn on Challenger.

Spray soapy solution on wear ring of jet pump.

Start and warm up engine.

▼ **CAUTION** : If boat is out of water, water must be supplied to cool engine with a garden hose.

Turning screw clockwise leans mixture and turning screw counterclockwise enriches mixture.

Turn low-speed mixture screw so that engine reaches the most suitable idle and runs smoothly. Make sure engine reacts quickly when pushing throttle lever(s).

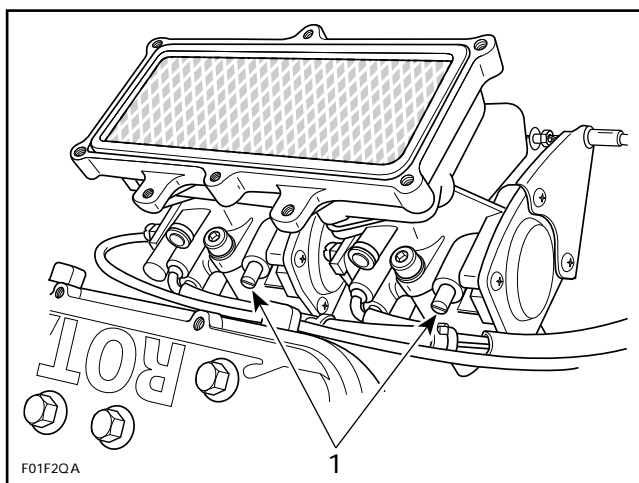
Both low-speed mixture screws must be adjusted exactly the same way. Never adjust screws more than 1/4 turn at a time.

16, High-Speed Mixture Screw

The high-speed mixture screw is sealed with a plastic cap that allows an adjustment of 1/4 turn.

○ **NOTE** : Turning screw 1/4 turn counterclockwise enriches mixture and turning screw clockwise leans mixture.

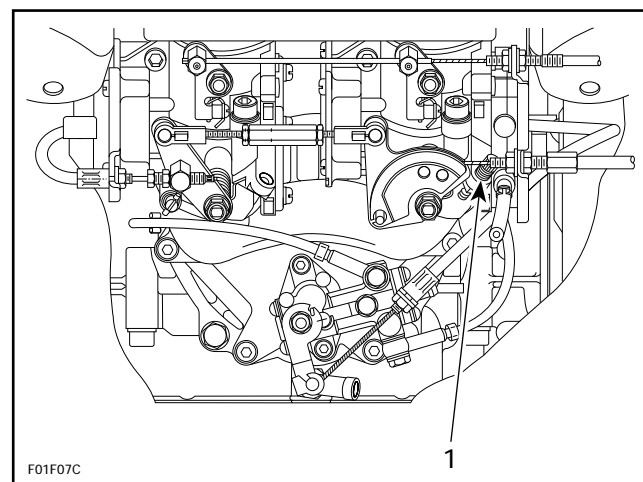
▼ **CAUTION** : Do not attempt to adjust high-speed mixture screw. Severe engine damage can occur.



TYPICAL

1. High speed screws

15, Idle Speed Screw



717 ENGINE SHOWN

1. Idle speed screw

Turning screw clockwise increases engine idle speed and turning screw counterclockwise decreases engine idle speed.

○ **NOTE** : There is only one idle speed screw for both carburetors. It is located on the MAG side carburetor.

Connect an induction-type tachometer (P / N 295 000 100) on spark plug cable of magneto side to measure engine speed.

○ **NOTE** : To adjust idle speed, ensure flame arrester and air intake silencer are installed.

Spray a soapy solution on wear ring of jet pump.

Start engine and bring to normal operating temperature.

▼ **CAUTION** : If boat is out of water, water must be supplied to cool engine with a garden hose.

Turn screw so that engine idles at 1500 RPM (in water). If boat is out of water, idle speed should be 3000 RPM.

◆ **WARNING** : Make sure idle speed screw contacts stopper when throttle lever is fully pulled back. Otherwise, readjust throttle cable.

FUEL SYSTEM PRESSURIZATION

◆ **WARNING** : Whenever doing any type of repair on jet boat or if any components of the fuel system are disconnected, a pressure test must be done before starting engine and / or releasing jet boat to customer.

Section 06 FUEL SYSTEM

Sub-Section 03 (CARBURETORS)

▼ **CAUTION** : Ensure to verify fuel line ends for damage. Always cut damaged end before reinstallation.

Pressure Test

Proceed as follows :

- Fill up fuel tank.
- Ensure to firmly tighten fuel tank cap. Remove vent hose from boat's body.
- Install an adapter on pump gauge tester to match vent hose (1/4 to 5/8 in)
- Connect pump gauge tester (P / N 295 000 085) to vent hose.
- Turn fuel valve(s) to OFF and pressurize fuel system to 34 kPa (5 PSI). If no leaks are found, turn fuel valves to ON (one at a time on Speedster) and pressurize once more.
- If pressure is not maintained locate leak and repair /replace component leaking. To ease leak search spray a solution of soapy water on components, bubbles will indicate leak location. Ensure the leak does not come from vent hose that could not be sealed completely.

○ **NOTE** : To minimize time of fuel system pressurization the fuel tank should be quite full. The system must maintain a pressure of 34kPa (5pPSI) during 10 minutes. Never pressurize over 34 kPa (5pPSI).

◆ **WARNING** : If any leak is found, do not start the engine and wipe off any fuel leakage. Failure to correct a leak could lead to an explosion. Do not use electric powered tools on watercraft unless system has been verified for no leaks.

Reconnect vent hose of fuel tank vent on body.

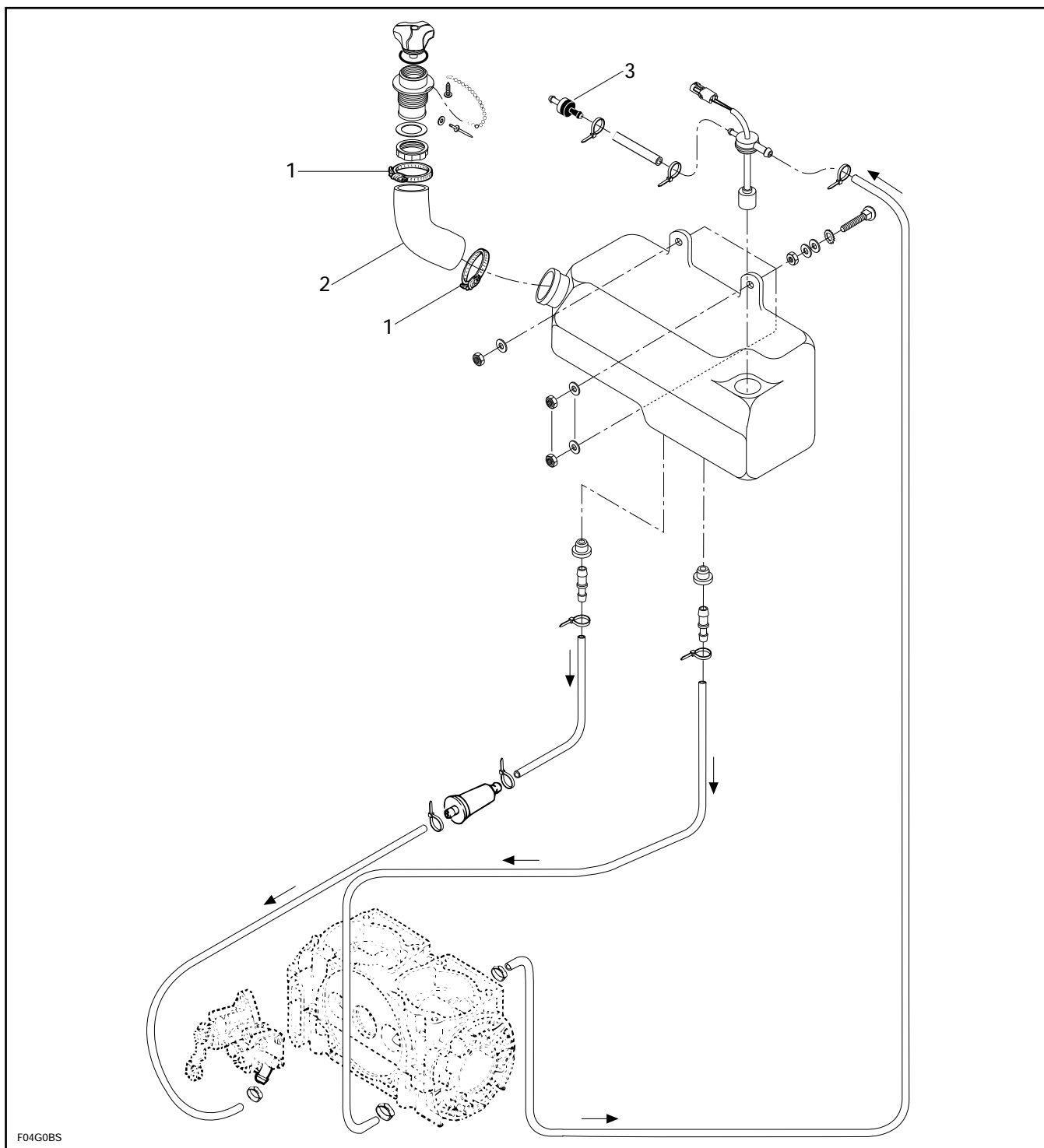
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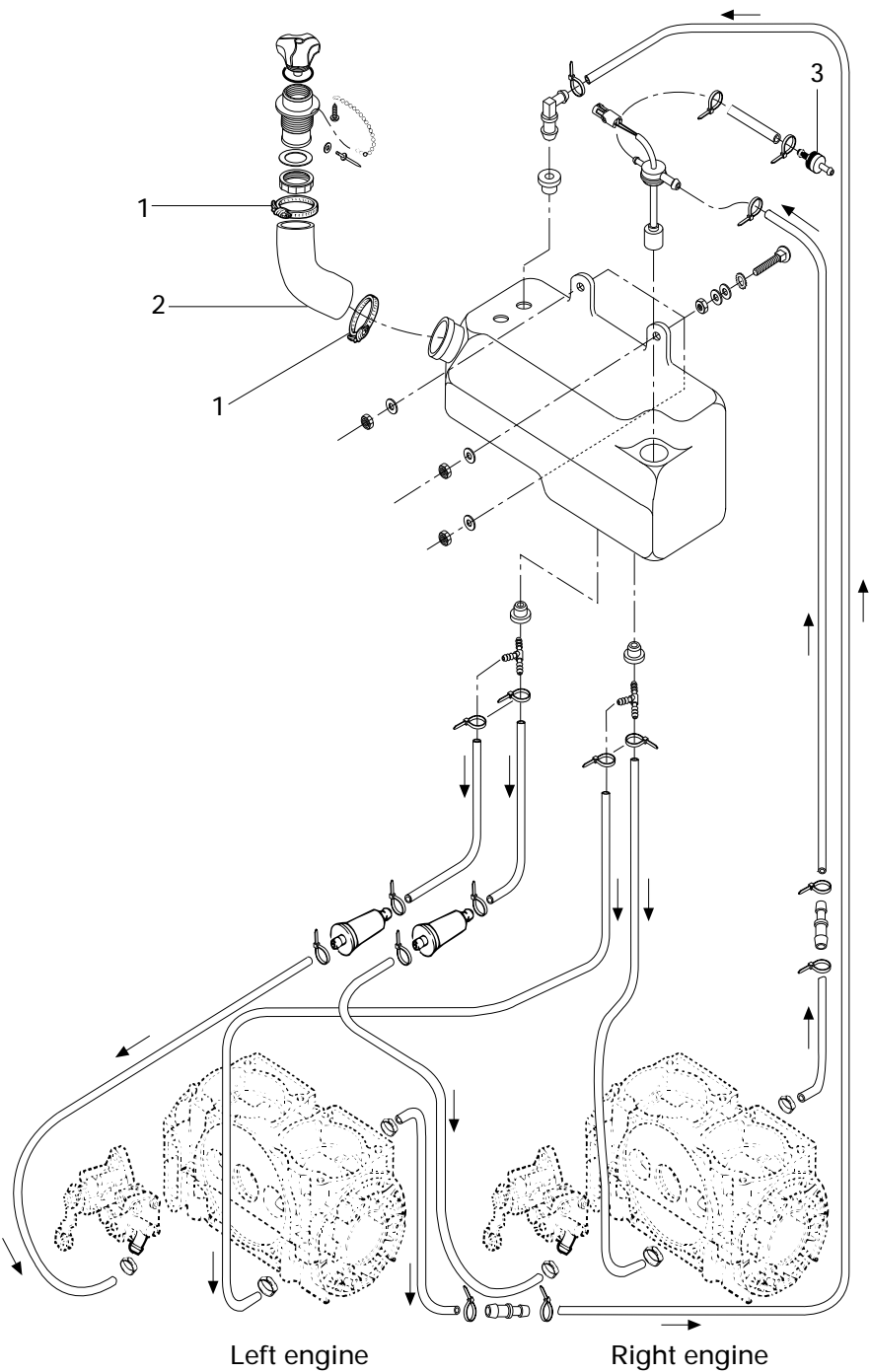
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OIL INJECTION RESERVOIR

Sportster and Challenger



Speedster



F04G0CS

GENERAL

Whenever repairing the oil injection system, always verify for water infiltration in reservoir.

1,2, Clamp and Hose

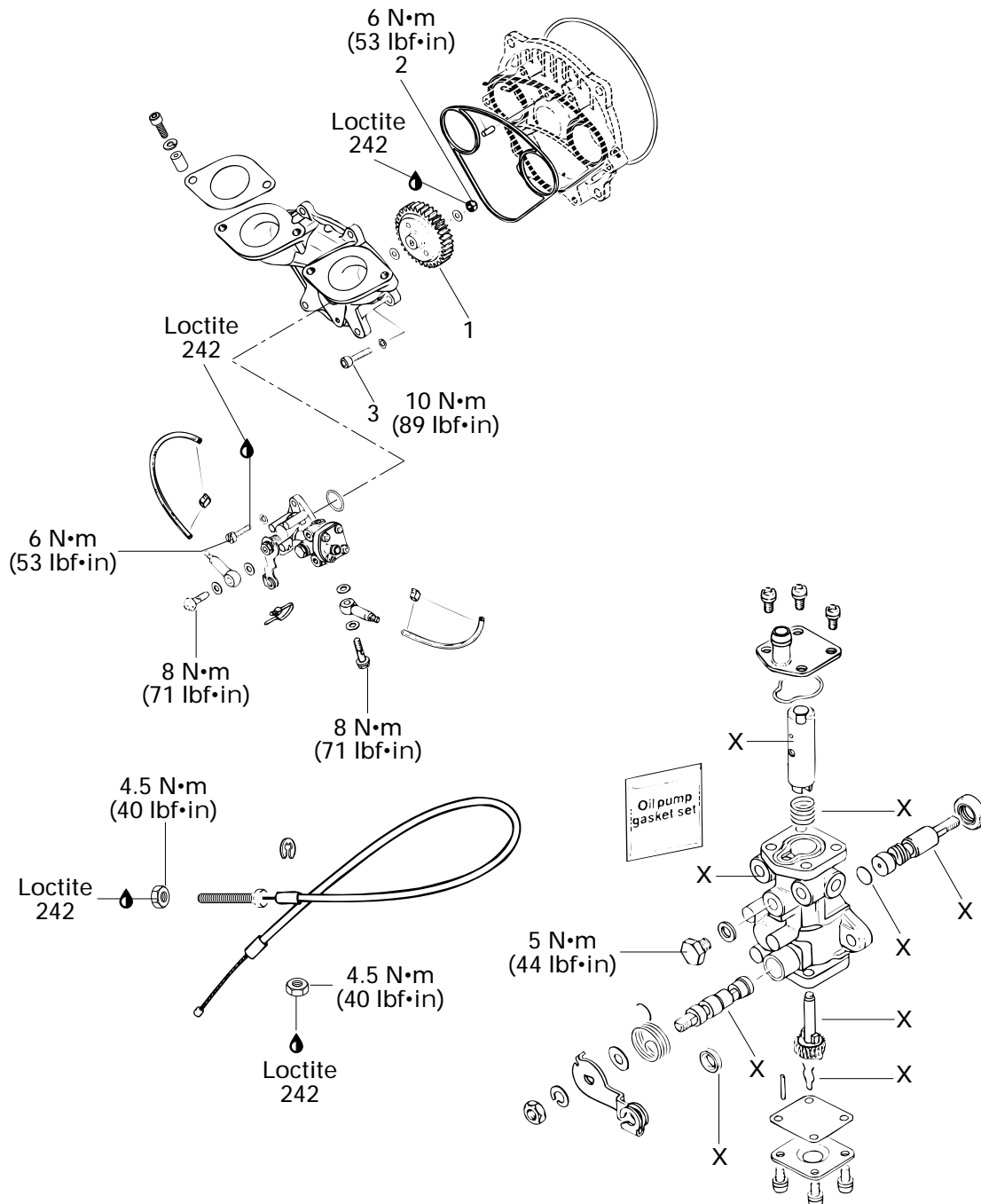
Verify oil filler neck hose for damage. Always ensure that clamps are well positioned and tightened. Torque clamps to 3 N•m (27 lbf•in).

3, Check Valve

Black side of the one-way check valve is the valve outlet. It allows air to get in reservoir.

OIL INJECTION PUMP

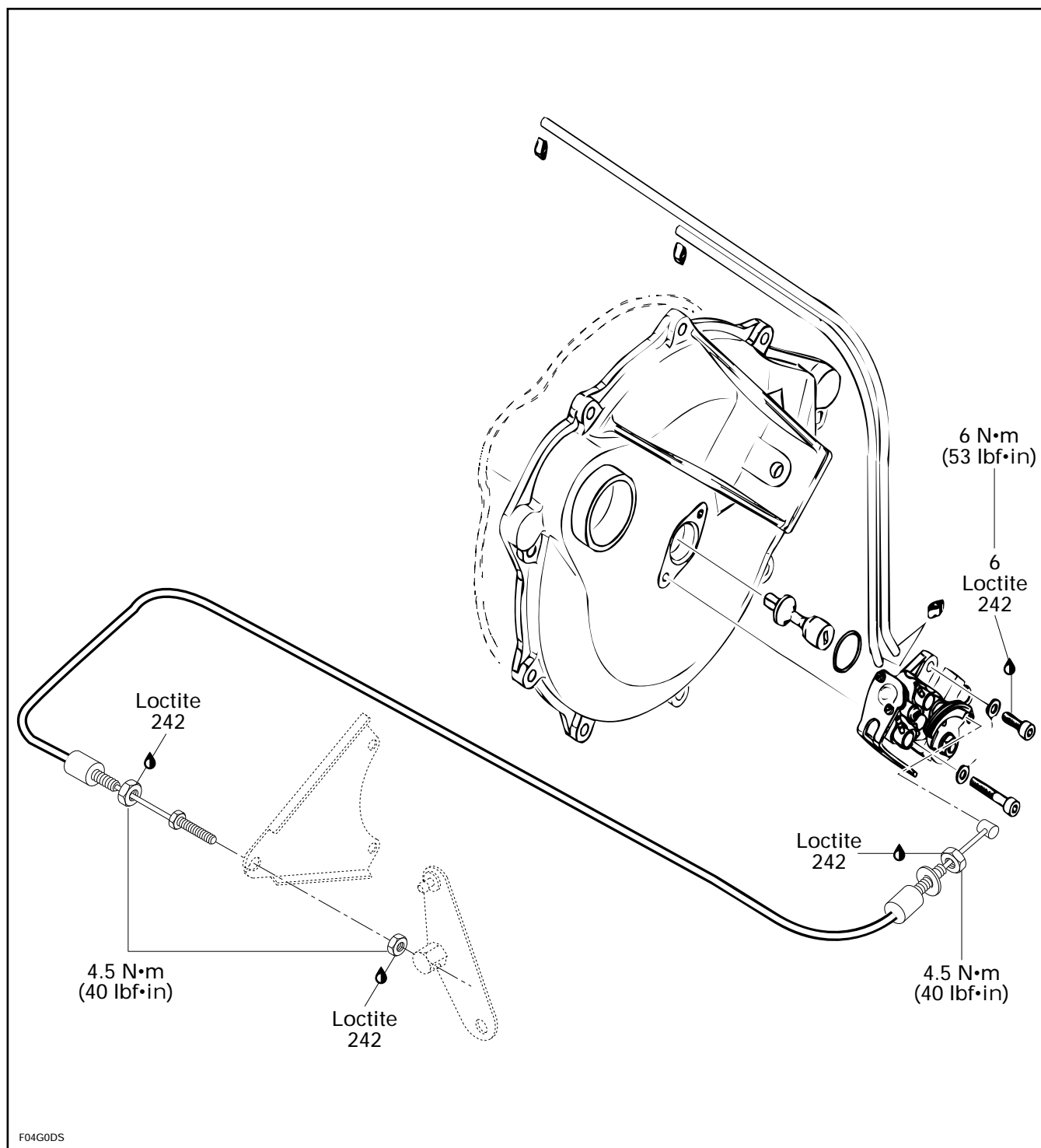
Sportster and Speedster



F04G0FS

Section 07 LUBRICATION SYSTEM
Sub-Section 02 (OIL INJECTION PUMP)

Challenger

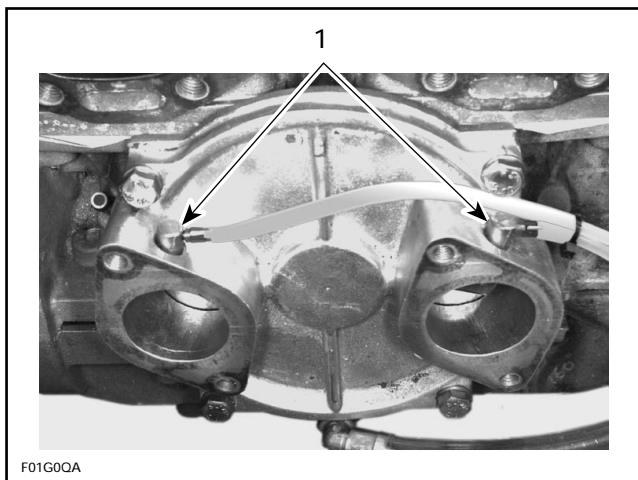


Challenger Only

The oil injection pump is located on the magneto housing cover and is driven directly by the crankshaft.

Oil pump flow rate at 1500 RPM for 30 seconds is 0,71 - 0,87 mL for each port.

Check valves are located on the rotary valve cover.



1. Check valves

CLEANING

All Models

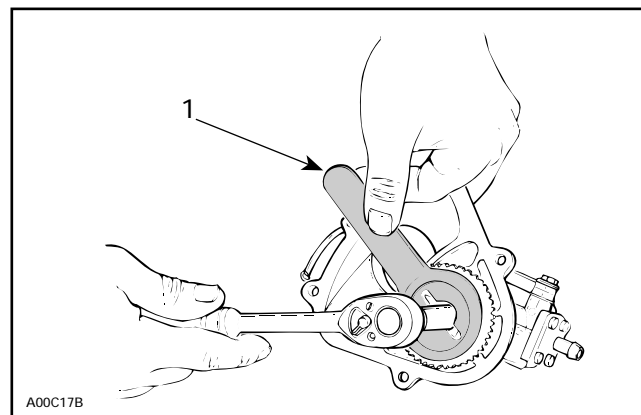
Discard all seals and O-rings. Clean metal components in a solvent.

DISASSEMBLY

NOTE : Some oil pump parts are not available in single parts.

1,2, Oil Pump Gear and Lock Nut (Sportster and Speedster)

To remove retaining nut, lock gear using gear holder (P / N 290 277 905).

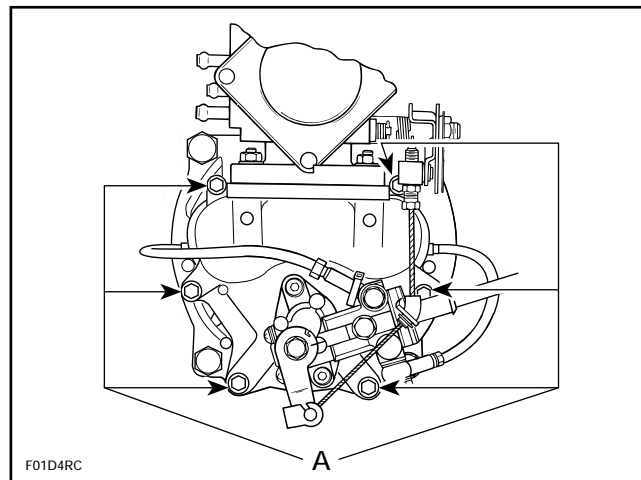


1. Gear holder

ASSEMBLY

3, Screw (Sportster and Speedster)

Torque to 10 N•m (89 lbf•in).



TYPICAL

A. 10 N•m (89 lbf•in)

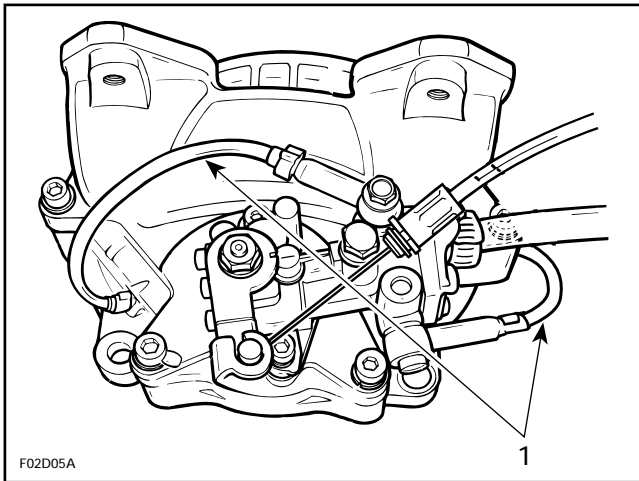
2, Lock Nut (Sportster and Speedster)

Apply Loctite 242 (blue) on nut threads and torque to 6 N•m (53 lbf•in).

CAUTION : Whenever oil injection lines are removed, always make the routing as shown.

Section 07 LUBRICATION SYSTEM

Sub-Section 02 (OIL INJECTION PUMP)



1. Oil injection lines

ADJUSTMENTS

Synchronization (All Models)

Ensure carburetor butterfly(ies) is(are) in closed position.

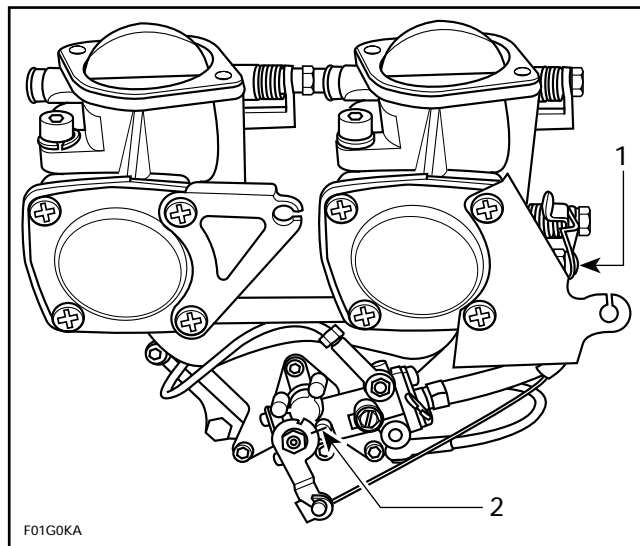
○ **NOTE** : Make sure carburetors are properly synchronized. If necessary, refer to FUEL SYSTEM 06-03, then look for **Carburetor Synchronization**.

Turn idle speed screw until it contacts stopper.

Turn idle speed screw 2 turns.

Turn cable adjustment screw of pump to align marks on pump.

○ **NOTE** : A mirror may be used to facilitate this verification.



TYPICAL

1. Adjustment screw (not shown)
2. Aligned marks

Tighten jam nut and recheck alignment marks.

▼ **CAUTION** : Proper oil injection pump adjustment is very important. Any delay in the opening of pump can result in serious engine damage.

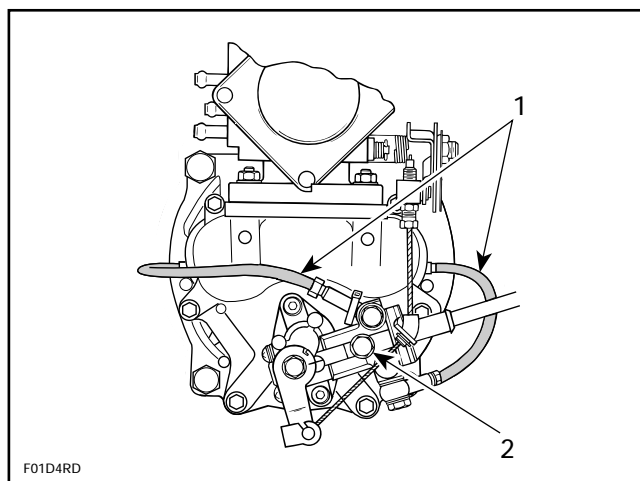
Bleeding

▼ **CAUTION** : Oil injection system must be bled and adjustment checked before operating engine.

Ensure oil injection reservoir is sufficiently filled.

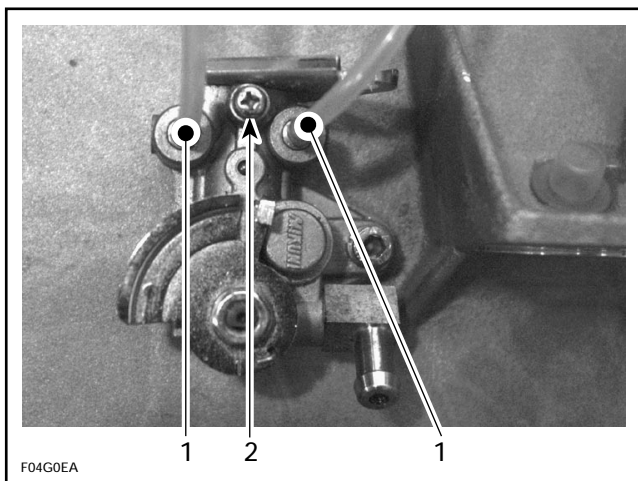
Install a dry rag below oil injection pump.

Remove bleed screw to allow oil to flow.



TYPICAL - SPORTSTER AND SPEEDSTER

1. Must be full of oil
2. Bleed screw



CHALLENGER

1. Must be full of oil
2. Bleed screw

Keep bleeding until all air has escaped from line. Make sure no air bubbles remain in oil feed line.

Reinstall and tighten bleed screw.

Wipe any oil spillage.

Check small oil lines between pump and intake manifold. They must be full of oil.

If not, run engine at idle speed while manually holding pump lever in fully open position. Do not activate throttle lever.

CAUTION : Water must be supplied to cool engine with a garden hose.

CHECKING OPERATION

On Boat

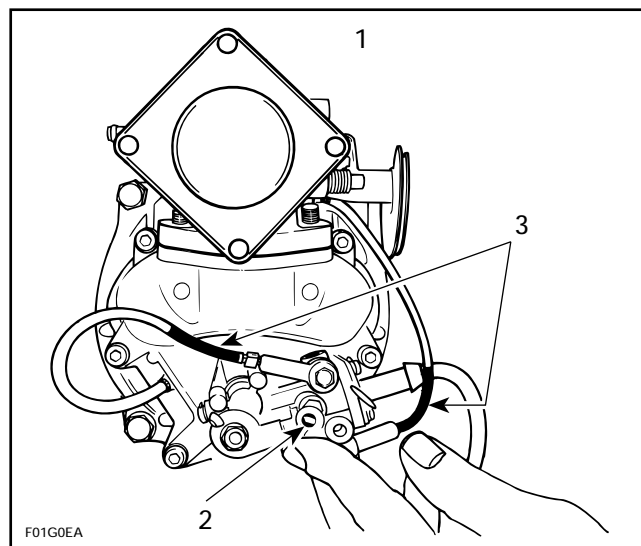
Sportster and Speedster Only

NOTE : Oil line supply must be full of oil. See bleeding procedure above.

Unscrew banjo fittings from pump. Start engine and stop it as soon as it fires.

Ensure that oil level in small oil lines is passed the unpainted area. Repeat the procedure until this condition is attained.

Reconnect banjo fittings with a washer on each side and torque screws to 8 N•m (71 lbf•in). Start engine and run at idle while holding the pump lever in fully open position. Oil columns must advance into small oil lines.



TYPICAL

1. Engine at idle
2. Fully open position
3. Oil columns advancing

If not, remove pump assembly and check the pump gear for defects, replace as necessary. Test pump as described below:

NOTE : Through normal use, oil level must not drop in small tubes. If oil drops, verify check valve operation in banjo fittings. Replace as necessary.

On a Bench Test

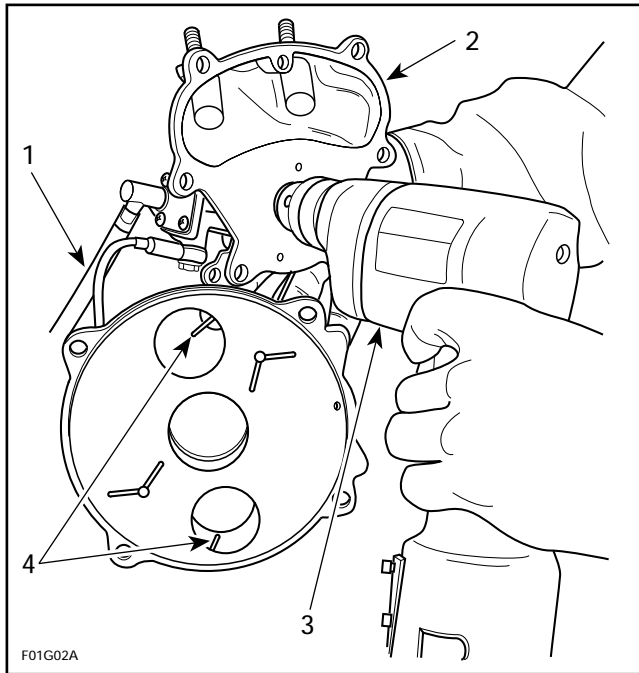
All Models

The oil pump must be removed out of boat.

Connect a hose filled with injection oil to main line fitting. Insert other hose end in an injection oil container. Using a counterclockwise (reverse position) rotating drill rotate pump shaft. Oil must drip from fittings in parts of rotary valve cover while holding lever in a fully open position. If not replace pump.

Section 07 LUBRICATION SYSTEM

Sub-Section 02 (OIL INJECTION PUMP)



TYPICAL

1. Main oil line to an oil container
2. Hold lever in fully open position
3. Counterclockwise (reverse) rotating drill
4. Oil must drip here

OIL SYSTEM PRESSURIZATION

CAUTION : Whenever oil system components are disconnected or replaced, a pressure test must be done before starting engine and / or releasing watercraft to customer. Ensure to verify oil line ends for damage. Always cut damaged end before reinstallation.

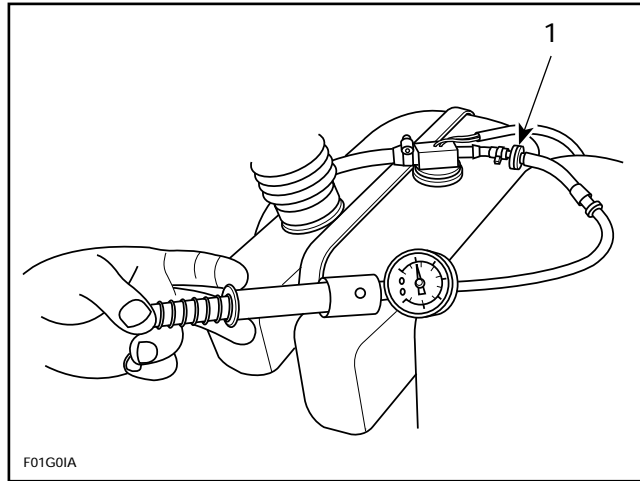
Pressure Test

NOTE : On Speedster model, ensure to plug oil lines for each engine.

Proceed as follows :

- Fill up oil reservoir. Ensure cap is properly tightened.
- Install hose pinchers on oil inlet lines close to oil pump and to rotary valve.
- Install a hose pincher on oil return line.
- Connect pump gauge tester to oil reservoir vent inlet line.
- Pressurize oil system to 21 kPa (3 PSI). If pressure is not maintained, locate leak and repair / replace component leaking. To ease leak search spray a solution of soapy water on components, bubbles will indicate leak location.

NOTE : To minimize time of oil system pressurization the oil reservoir should be quite full. The system must maintain a pressure of 21 kPa (3 PSI) for at least 10 minutes. Never pressurize over 21 kPa (3 PSI).



TYPICAL

1. Connect pump to check valve

CAUTION : If any leak is found, do not start the engine and wipe off any oil leakage. Failure to correct a leak could cause serious damage to engine components.

Remove hose pinchers from inlet lines and return line(s).

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Section 08 ELECTRICAL
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OVERVIEW

717 ENGINE

The electrical system consist of different sub-systems where some are inter-related.

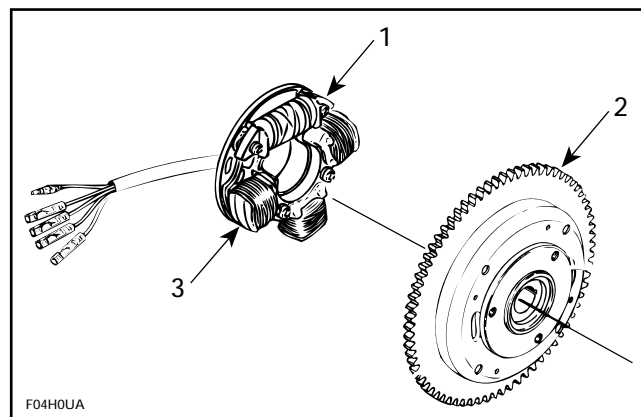
The magneto is coupled to the engine and produces electrical energy for the ignition system and the charging system. Its outputs are directed toward the ignition coil as well as the charging system and some circuits through the MPEM (Multi-Purpose Electronic Module).

In the charging system, the battery supplies the MPEM, the starting system and the accessories. The following gives an outline of each components.

There are different voltage types (A.C. (alternating current) and D.C. (direct current)) and voltage levels (0 to 40 000 Vac, 5 Vdc and 12 Vdc). There is unregulated A.C. from magneto for the charging system and the ignition system. For the charging system, the A.C. current is rectified to D.C. and regulated to 12 Vdc for MPEM, gauges, accessories and electrical system. The MPEM lowers the voltage level to 5 Vdc for its internal circuitry and some external components (neutral switch). For the ignition system, the A.C. voltage from the magneto is stepped up to 40 000 V. Keep that in mind when dealing with voltages in the electrical system.

MAGNETO SYSTEM

It is the primary source of electrical energy. It transforms magnetic field into electric current through generator coil for the ignition system and through another separate 3-pole generator coil for the charging system.



1. Ignition system generator coil
2. Magneto flywheel
3. Charging system generator coil

IGNITION SYSTEM (single generator coil)

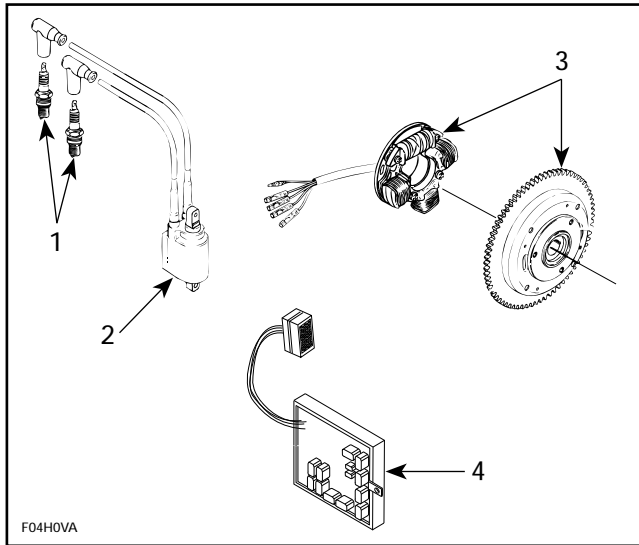
IGNITION COIL (with integrated ignition module) AND SPARK PLUGS

The ignition coil integrates the electronic circuitry of the CDI (ignition module). The CDI circuitry receives its primary electric current from magneto via 2 wires which charges its capacitor. The CDI circuitry controls the ignition timing and generates the spark occurrence by discharging the current stored in its capacitor to ignition coil.

The primary windings of ignition coil (connected to CDI circuitry internally) receives the electrical energy from the CDI circuitry. The ignition coil jumps this voltage to a high level in secondary windings to produce a spark at spark plug.

Section 08 ELECTRICAL

Sub-Section 01 (OVERVIEW)



1. Spark plugs
2. Ignition coil with integrated ignition module
3. Magneto system
4. MPEM (Multi-purpose Electronic Module)

MPEM (MULTI-PURPOSE ELECTRONIC MODULE)

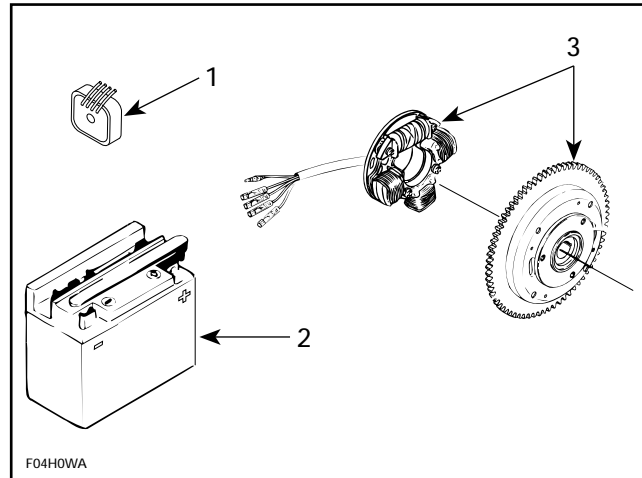
It is powered by the battery. The MPEM is the distribution center for electrical components and it includes an engine RPM limiter.

CHARGING SYSTEM

It receives its primary electric current from magneto via 2 wires which charges the battery. The magneto supply unregulated A.C. current to a voltage regulator / rectifier.

The half-wave rectifier receives the A.C. current and changes it to D.C. current to allow battery charging.

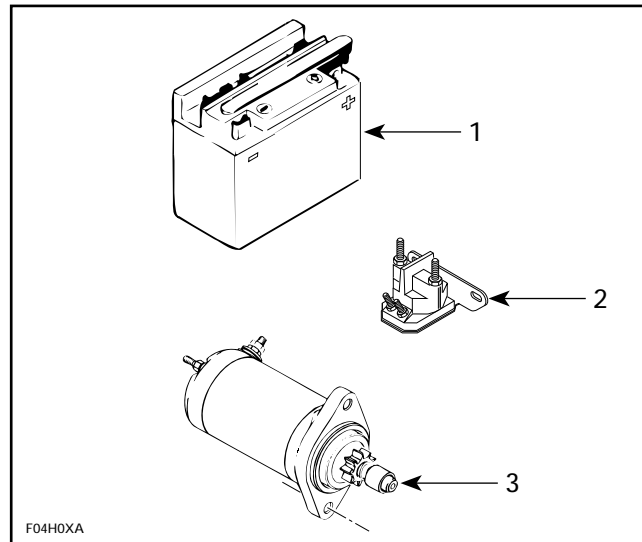
This regulated D.C. current then supplies the MPEM, starting system, the fuse block and the accessories.



1. Voltage regulator / rectifier
2. Battery
3. Magneto system

STARTING SYSTEM

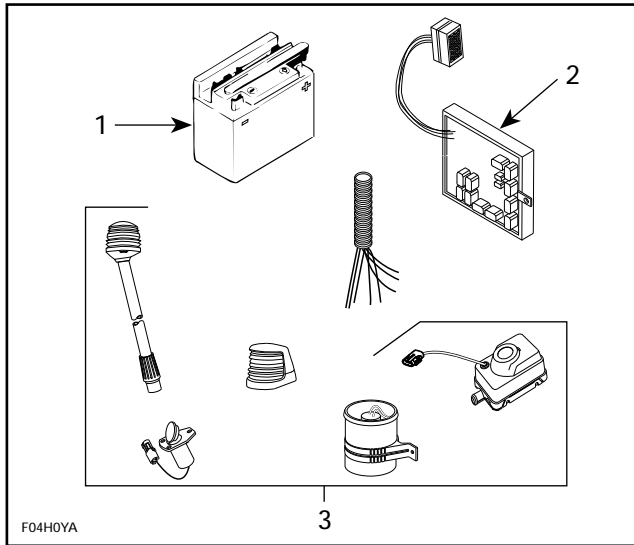
The battery supplies the D.C. current to the electric starter via a solenoid to start the engine.



1. Battery
2. Solenoid
3. Electric starter

GAUGES / ACCESSORIES

The battery supplies the D.C. current through the fuse block to the gauges and accessories.



1. Battery
2. Fuse block
3. Accessories

787 ENGINE

The electrical system consist of different sub-systems where some are inter-related.

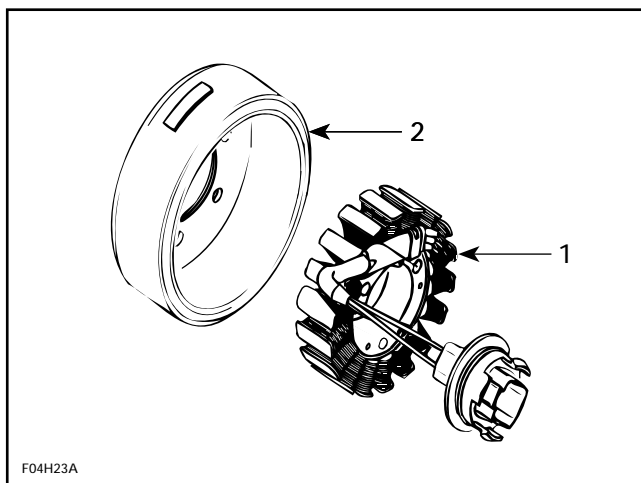
The magneto is coupled to the engine and produces electrical energy for the charging system. Its outputs are directed toward the charging system and some circuits through the MPEM (Multi-Purpose Electronic Module).

In the charging system, the battery supplies the ignition system MPEM, the starting system, the fuse block and the accessories. The following gives an outline of each components.

There are different voltage types (A.C. (alternative current) and D.C. (direct current)) and voltage levels (0 to 40 000 Vac, 5 Vdc and 12 Vdc). There is unregulated A.C. from magneto for the charging system. For the charging system, the A.C. current is rectified to D.C. and regulated to 12 Vdc for the ignition system MPEM, gauges, fuse block, accessories and electrical system. The MPEM lowers the voltage level to 5 Vdc for its internal circuitry and some external components (neutral switch). For the ignition system, the D.C. voltage from the battery is stepped up to 40 000 V. Keep that in mind when dealing with voltages in the electrical system.

MAGNETO SYSTEM

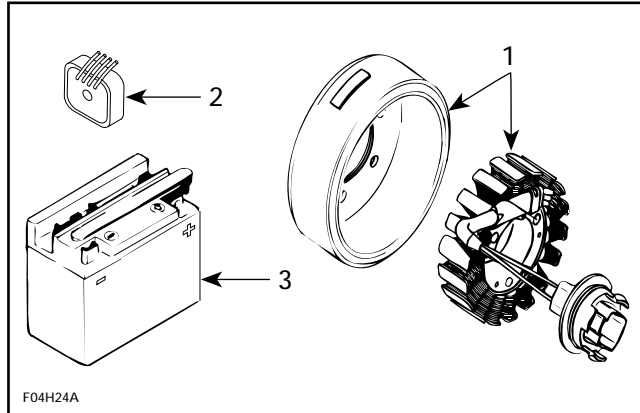
It is the source of electrical energy to charge the battery and keep it at a full state of charge. It transforms magnetic field into electric current through a 3 phase, "Y" wound stator on 18 poles.



1. Charging system generator coil
2. Magneto flywheel

CHARGING SYSTEM

It receives its primary electric current from magneto via 3 wires which charges the battery. The magneto supplies unregulated AC current to a voltage regulator / rectifier.



1. Magneto system
2. Voltage regulator / rectifier
3. Battery

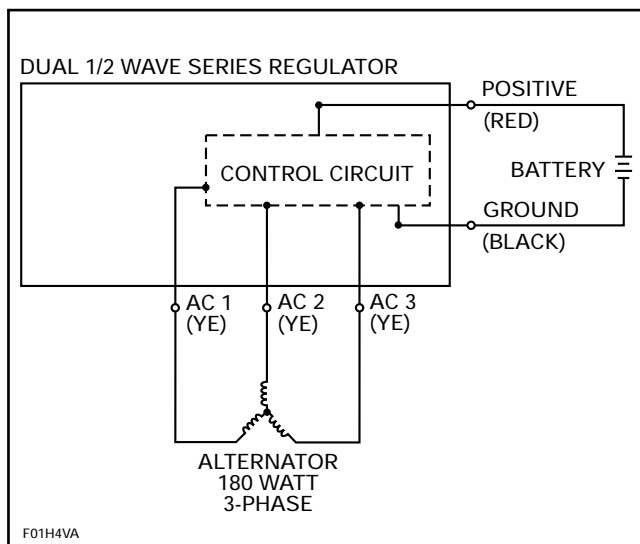
Rectifier / Regulator

A dual 1/2 wave series rectifier / regulator receives the AC voltage and rectifies it into DC. The system is regulated to a maximum of 14.5 - 14.8 volts (DC).

Battery

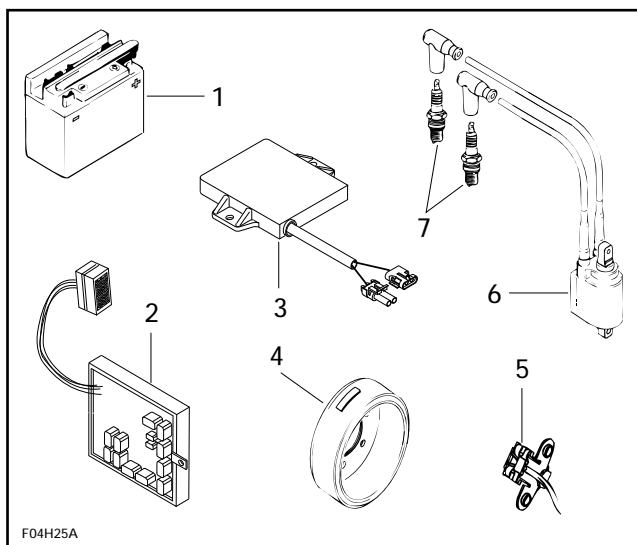
The battery is the DC source for the electric starter, multi-purpose electronic module (MPEM), DC-CDI module, fuse block and all accessories.

CHARGING CIRCUIT SCHEMATIC



IGNITION SYSTEM

A Digital DC-CDI (Direct Current-Capacitor Discharge Ignition) system is utilized on the 787 engine. The ignition system is made up of the following components:

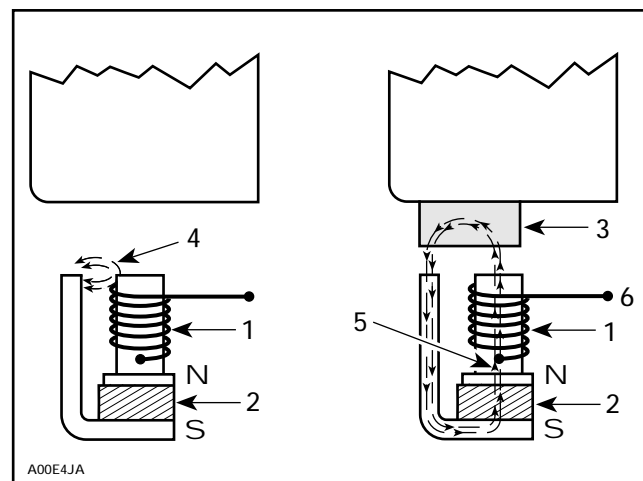


TYPICAL

- | | |
|--------------------------|------------------|
| 1. Battery | 5. Trigger coil |
| 2. MPEM module | 6. Ignition coil |
| 3. Digital DC-CDI module | 7. Spark plugs |
| 4. Flywheel / rotor | |

Magneto Rotor / Trigger Coil

The trigger coil is mounted outside the rotor (inside the magneto cover of the engine) and is not adjustable. It's purpose is to signal the DC-CDI to be conductive at the proper number of degrees before TDC (Top Dead Center). The rotor has two protrusions (180 degrees apart) that, when coupled with the trigger coil, accomplish the signaling.



- | | |
|---------------|-----------------------------------|
| 1. Coil | 4. Magnetic field outside of coil |
| 2. Magnet | 5. Magnetic field crossing coil |
| 3. Protrusion | 6. Current to CDI module |

Ignition Module DC-CDI

The DC-CDI module receives the input from the trigger coil and signals the ignition coil when to fire. It also has the rev limiter function built into its circuitry, as well as the ignition timing curve. The DC-CDI module is mounted in the electrical box.

Multi-Purpose Electronic Module (MPEM)

The MPEM has a micro-controller inside of its sealed case and basically is responsible for the DESS (Digitally Encoded Security System), interpreting information, distribution of information, and as a timed / untimed power source. The MPEM is mounted in the electrical box.

A relay is used to prevent discharge of the battery, through the ignition system, when the craft is not running. The relay is in the MPEM.

Ignition Coil

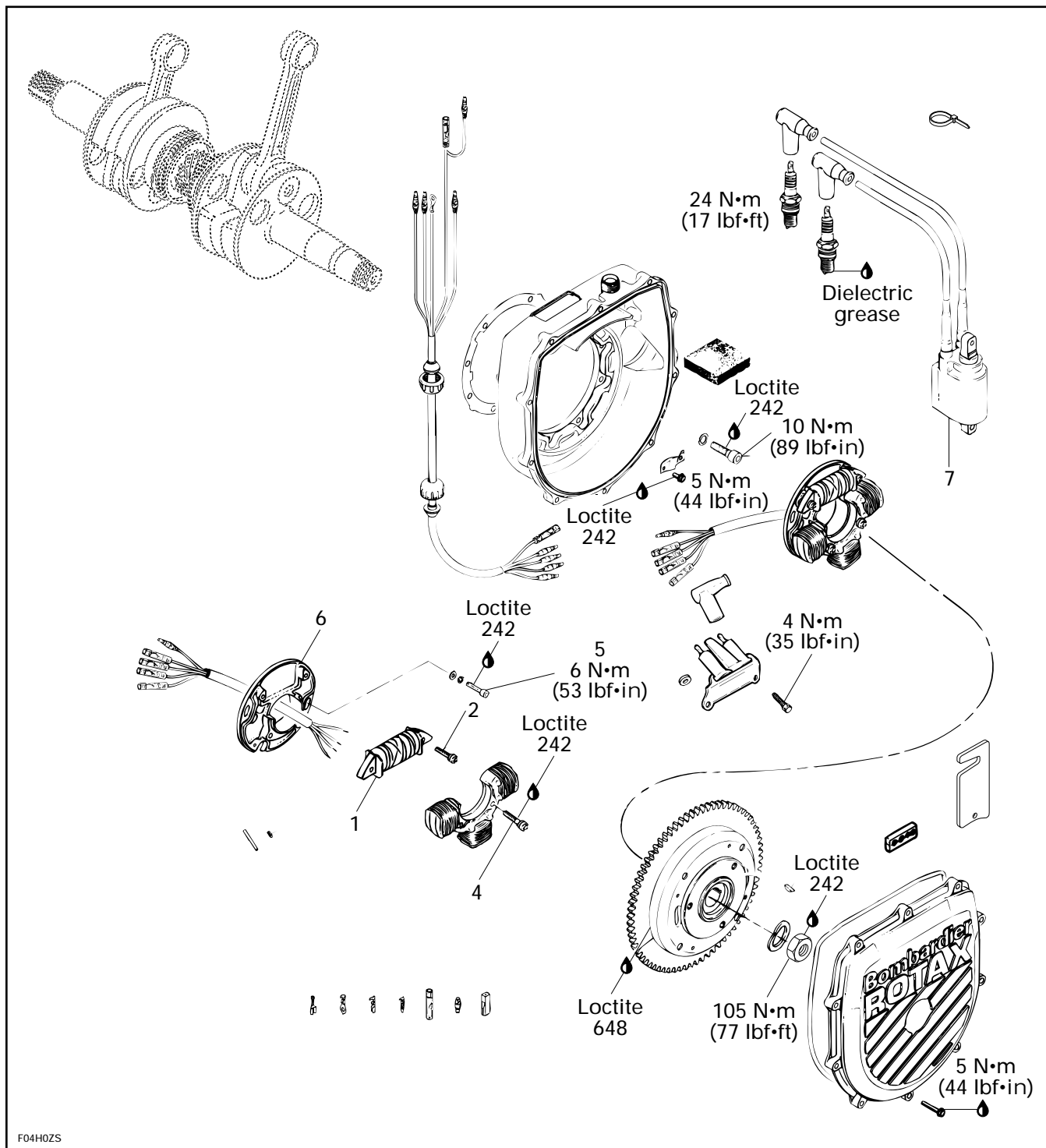
The ignition coil steps up the voltage input from the DC-CDI module and the end result is firing of the spark plugs. The coil is housed in the electrical box.

STARTING SYSTEM AND GAUGES / ACCESSORIES

These systems are the same as 717 engine. Refer to the previous pages.

MAGNETO SYSTEM

717 Engine



F04H0ZS

REMOVAL

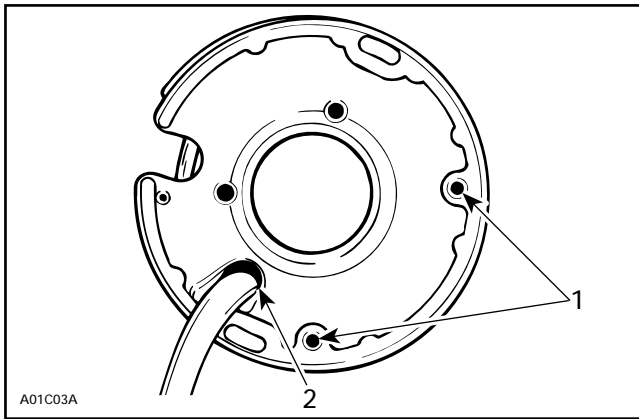
Refer to ENGINE section 04-03 then look for PTO Flywheel and Magneto for parts removal.

DISASSEMBLY

1, Ignition System Generator Coil (Single)

To replace generator coil :

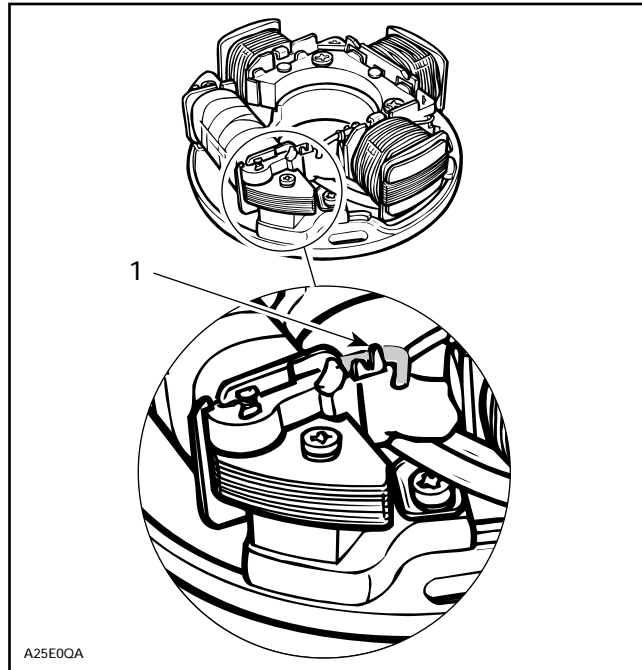
- Heat the armature plate to 93°C (200°F) around the screw holes to break the threadlocker bond.



1. Heat

▼ **CAUTION** : Protect harness from flame.

- Remove screws.
- Uncrimp and unsolder BLACK / RED wire from coil.



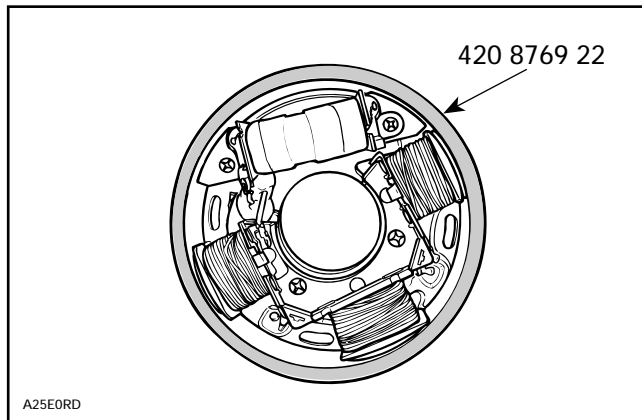
1. Uncrimp and unsolder wire here

- Strip end of old wire then crimp and solder on new coil.

1,2, Ignition System Generator Coil and Screw

Apply Loctite 242 (blue) to screws and install the new coil on armature plate.

Use magneto coil centering tool (P / N 290 876 922) and install so that it fits around armature plate before tightening screws.



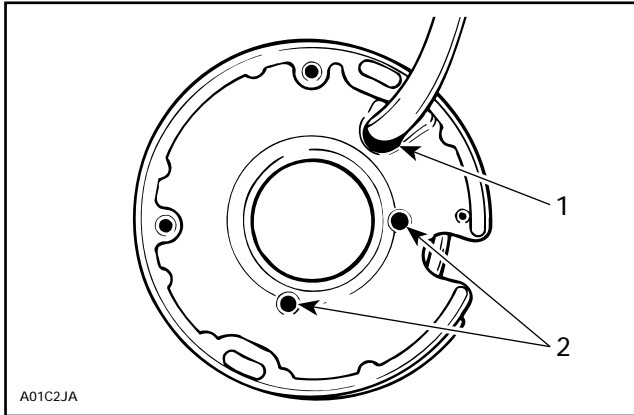
1. Magneto coil centering tool (P / N 290 876 922)

▼ **CAUTION** : Before reinstalling the magneto, remove the loose epoxy from harness.

3, Charging System Generator Coil

To replace :

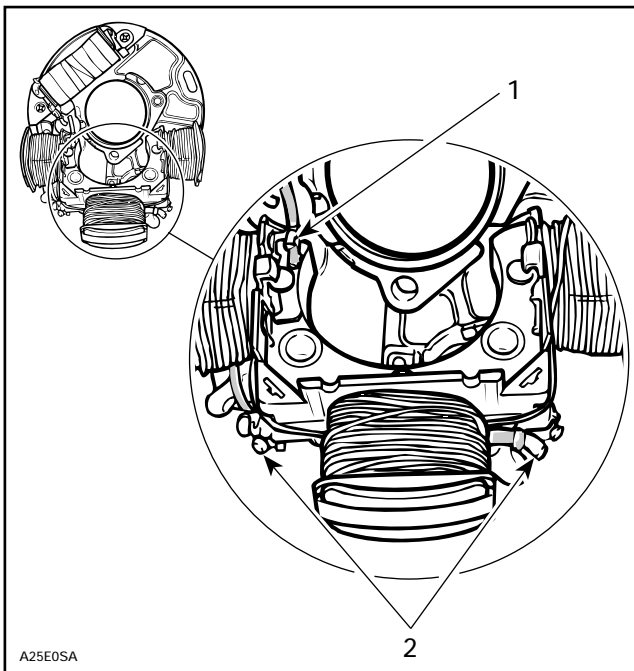
- Heat the armature plate to 93°C (200°F) around the screw holes to break the threadlocker bond.



1. Heat

▼ **CAUTION** : Protect harness from flame.

- Remove screws.
- Uncrimp and unsolder YELLOW and YELLOW / BLACK wires from coil.
- Uncrimp and unsolder ground wire (BLACK) from coil core.



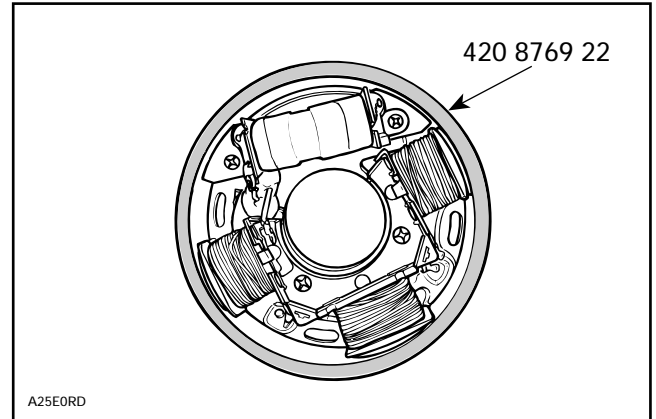
1. Uncrimp and unsolder ground wire (BLACK) here
2. Uncrimp and unsolder YELLOW and YELLOW / BLACK wires here

- Position new coil, crimp and solder all wires.

3,4, Charging System Generator Coil and Screw

Prior to assembly, apply Loctite 242 (blue).

Use magneto coil centering tool (P / N 290 876 922) and install it so that it fits around armature plate before tightening screws.



1. Magneto coil centering tool (P / N 290 876 922)

ASSEMBLY

○ **NOTE** : Always apply dielectric grease on all electrical connections.

5,6, Screw and Armature Plate

Position the armature plate on the crankcase, aligning the marks on both parts.

Apply a drop of Loctite 242 (blue) on screw threads and tighten.

7, Ignition Coil

Connect BLACK / RED / GREEN wire to ignition coil terminal (additional BLACK / RED on port engine of Speedster model).

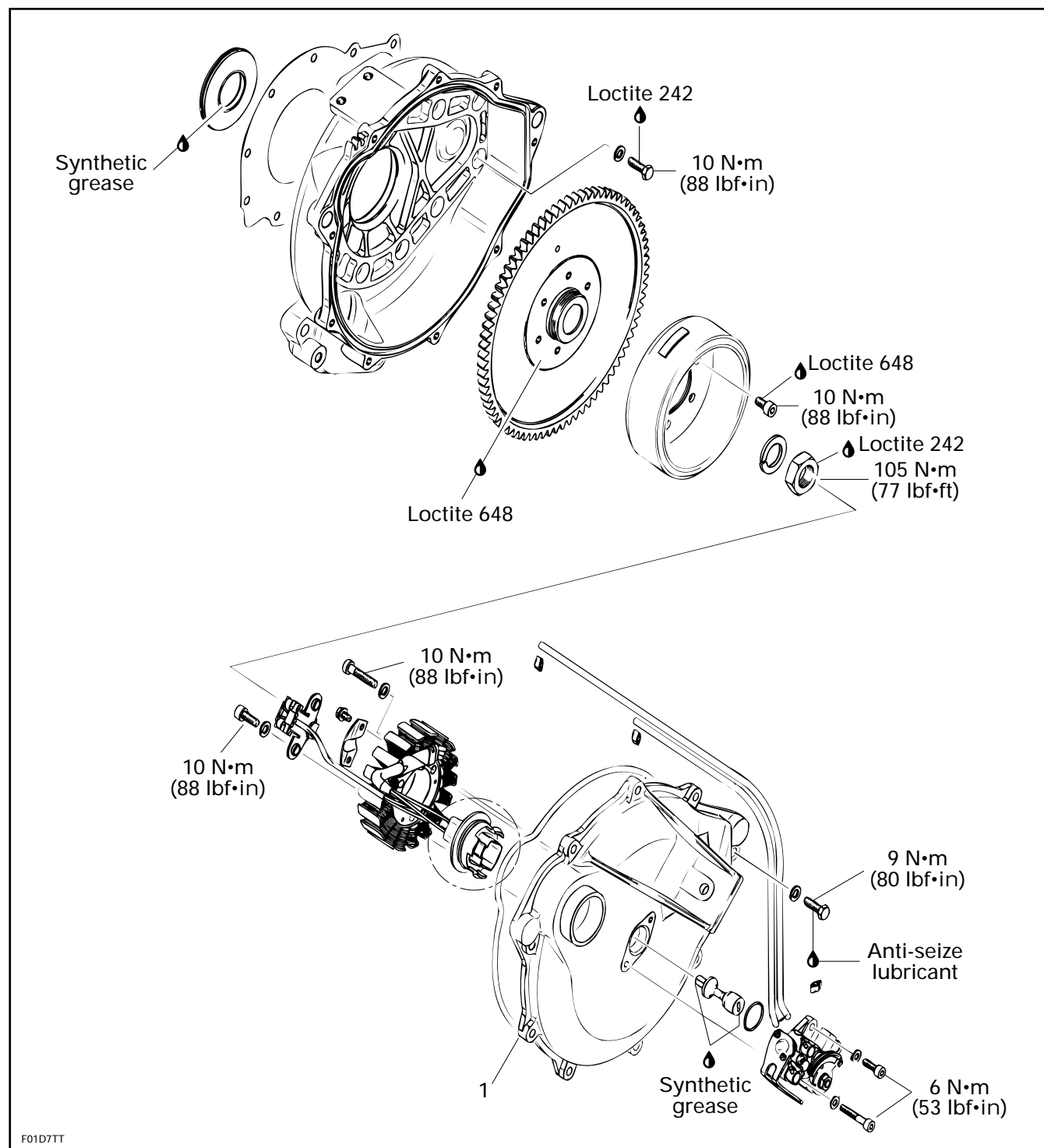
INSTALLATION

Refer to ENGINE section 04-03 then look for PTO Flywheel and Magneto for installation.

Perform ignition timing. Refer to Ignition System.

Section 08 ELECTRICAL
Sub-Section 02 (MAGNETO SYSTEM)

787 Engine



MAGNETO ROTOR AND ENGINE FLYWHEEL REMOVAL

Remove starter.

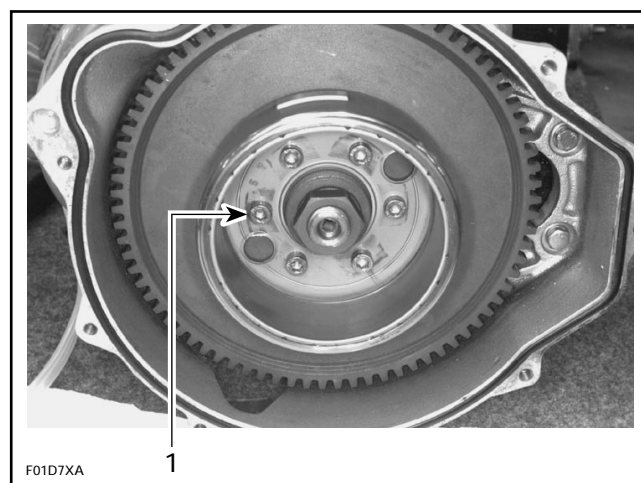
Lock ring gear using special tool (P / N 295 000 134).

1. Tool

Remove engine magneto cover.

If desired, magneto rotor can be removed without the engine flywheel. Remove the 6 screws.

NOTE : Make sure ring gear is locked with special tool.



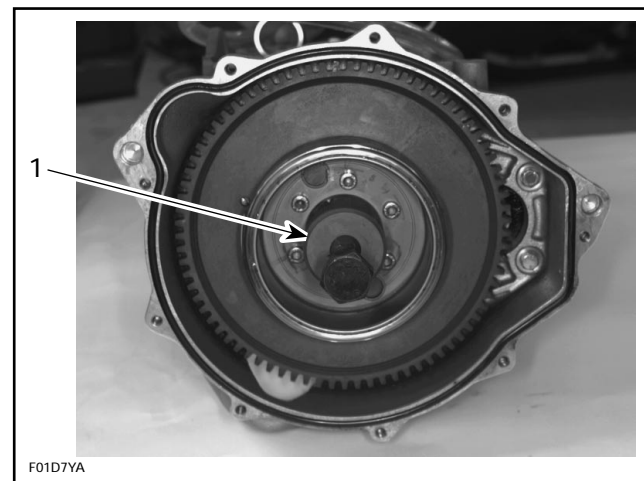
1. Screw

Using a suitable socket, unscrew retaining nut of engine flywheel COUNTERCLOCKWISE when facing it.

Remove special tool locking ring gear.

Engine flywheel is easily freed from crankshaft with puller (P / N 420 976 235) and crankshaft protective cap (P / N 290 876 557).

Insert crankshaft protector to outer end of crankshaft and fully thread puller in engine flywheel.



1. Puller

Tighten puller screw and at the same time, tap on screw head using a hammer to release engine flywheel from its taper.

ASSEMBLY

Assembly is essentially the reverse procedure of removal. However, pay attention to the following.

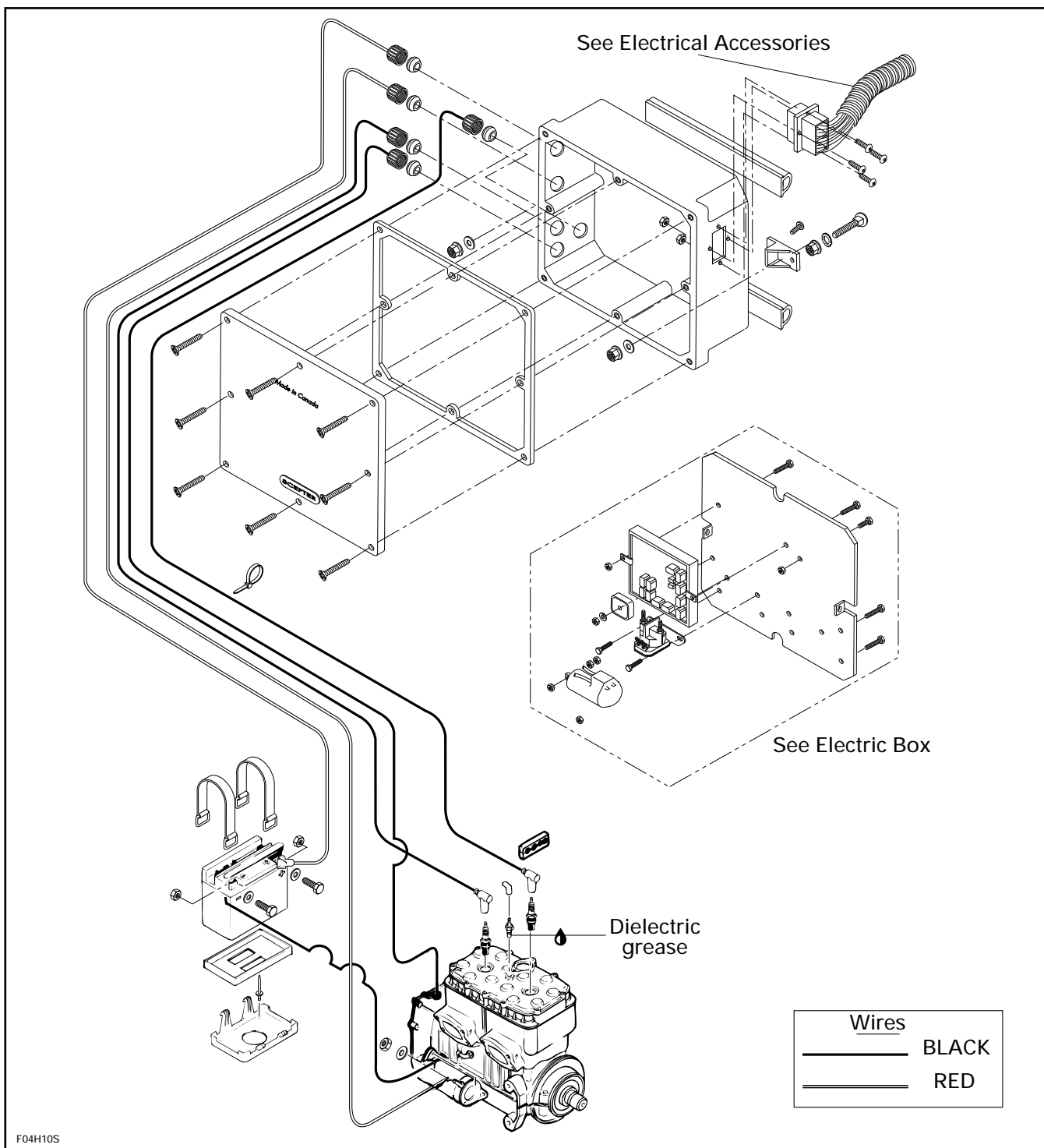
Refer to the main illustration at the beginning of this sub-section for torque specifications and service products to be used.

Perform ignition timing. Refer to **Ignition System**.

IGNITION SYSTEM

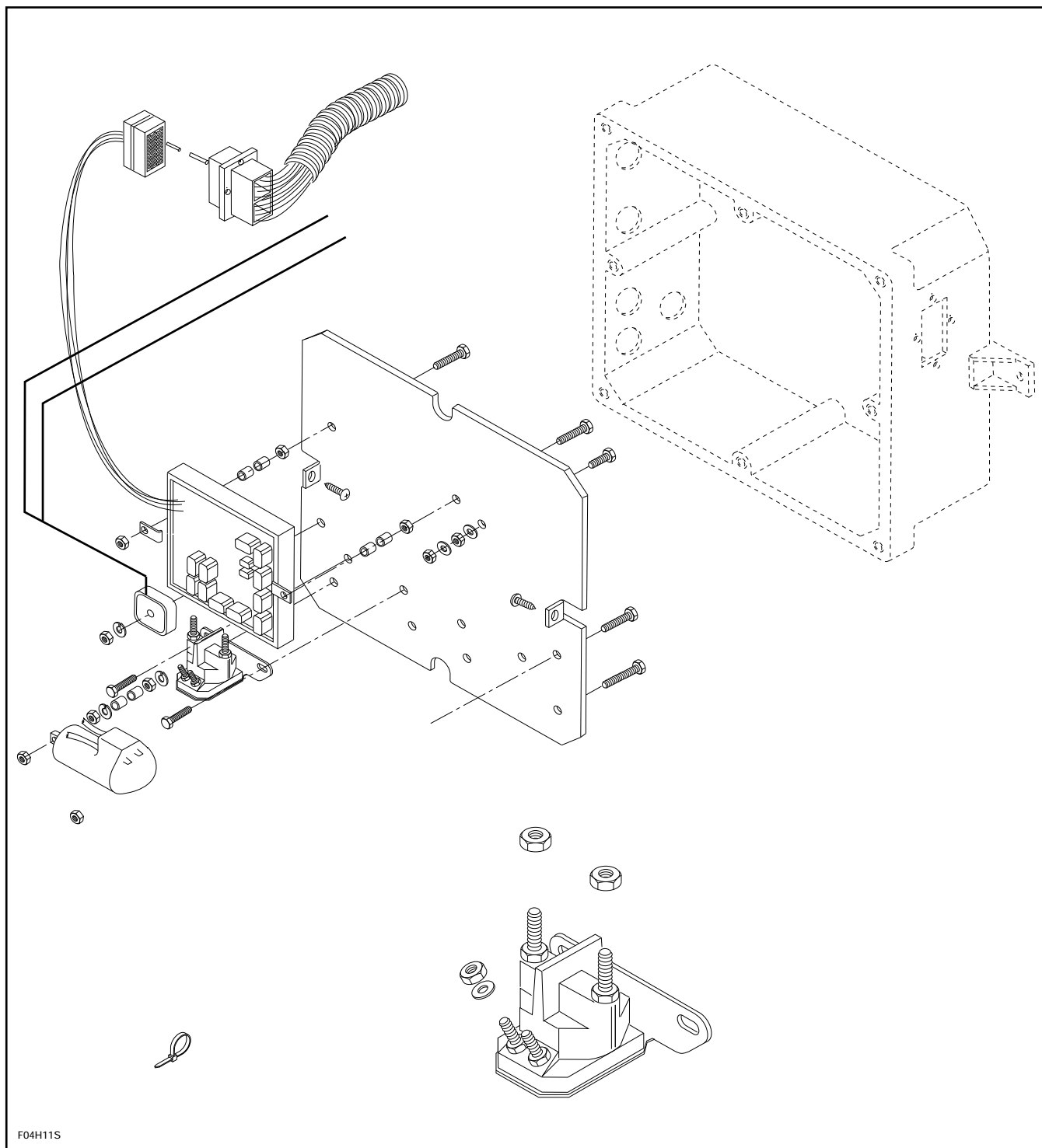
ELECTRICAL SYSTEM

Sportster



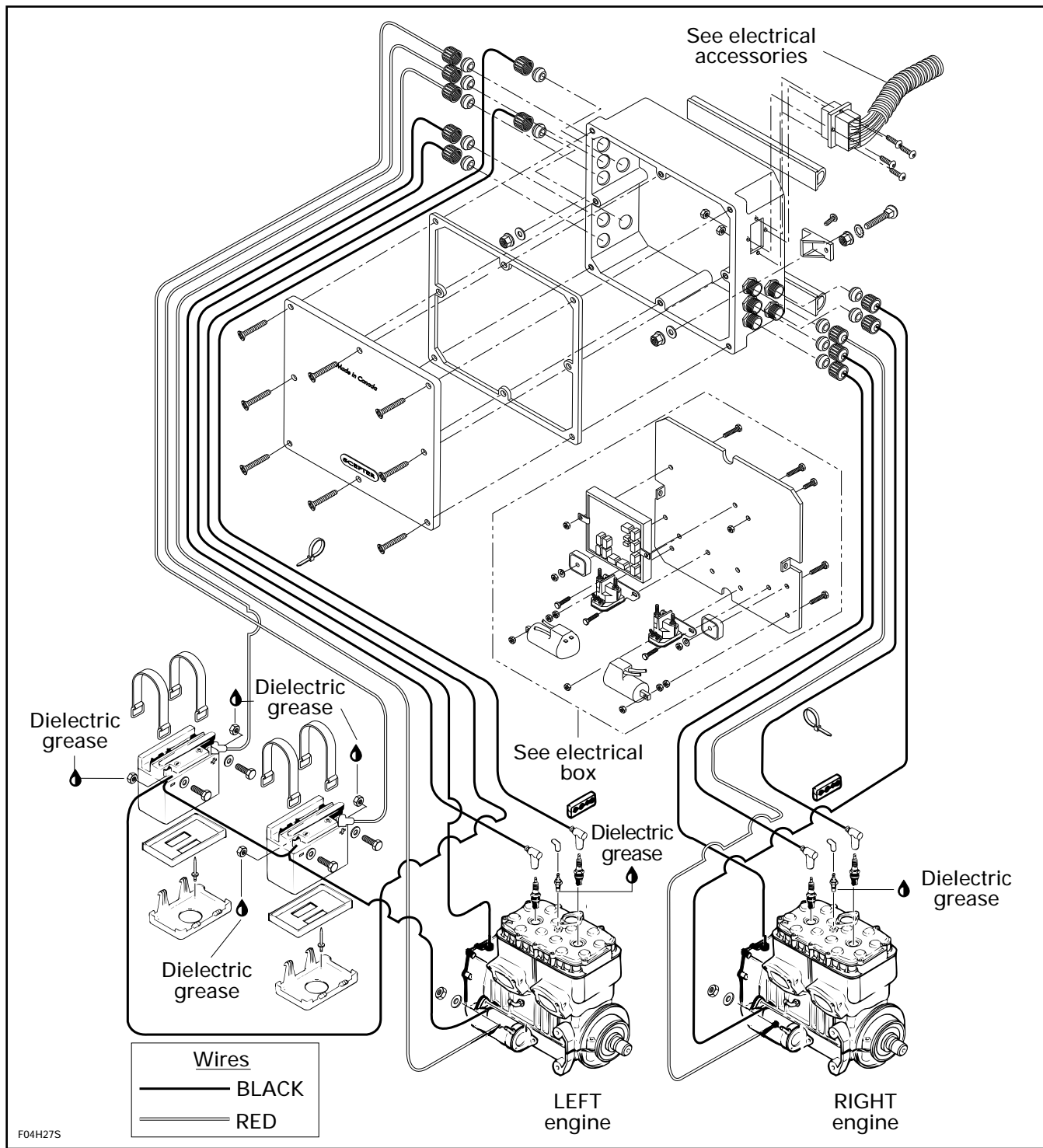
ELECTRICAL BOX

Sportster



ELECTRICAL SYSTEM

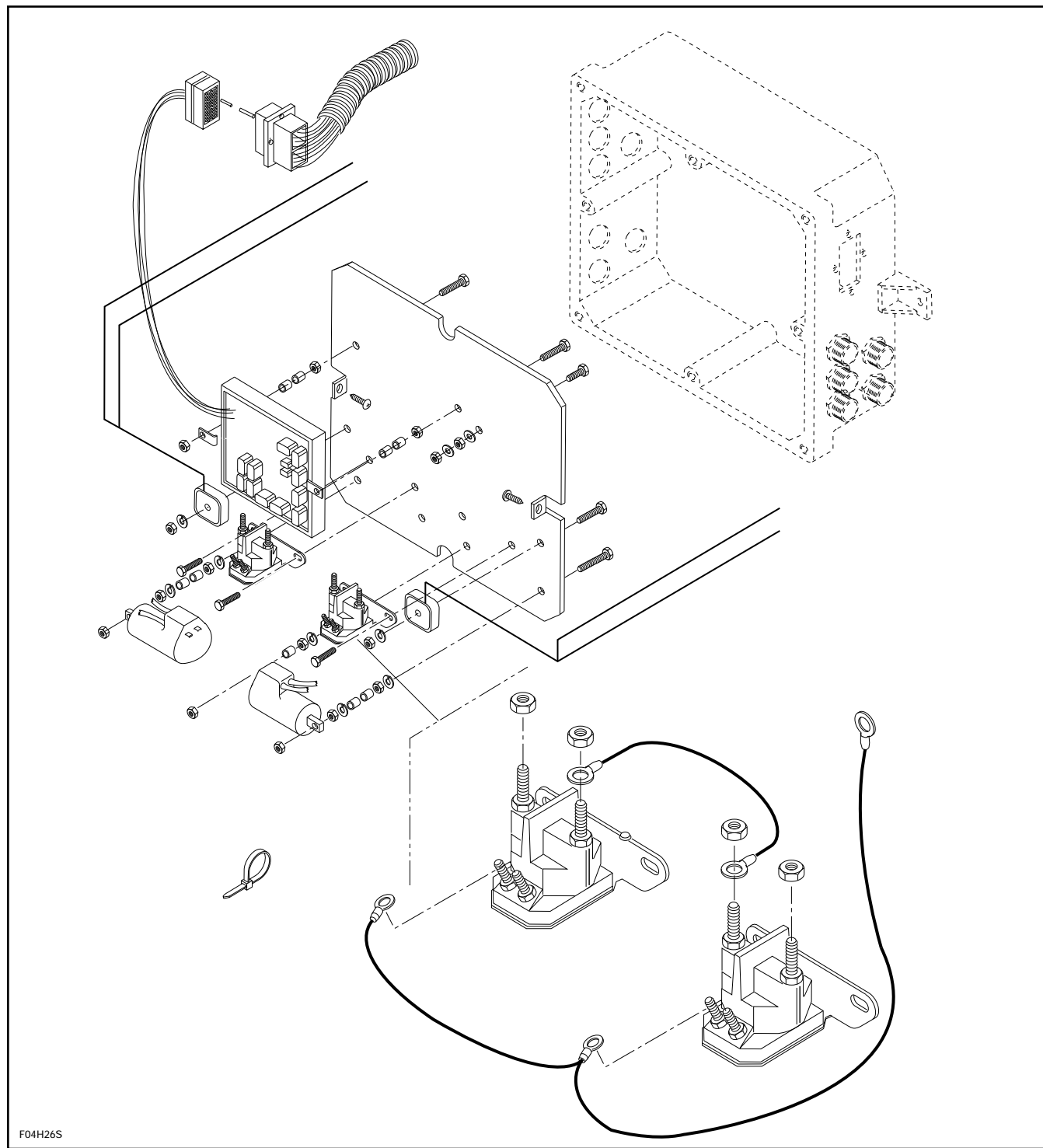
Speedster



F04H27S

ELECTRICAL BOX

Speedster



IGNITION SYSTEM TESTING PROCEDURE, 717 ENGINE

General

○ **NOTE :** The following section gives information for both Sportster and Speedster models. To make the section shorter, the Sportster is actually described and the differences for the Speedster are added. Relative to the Speedster, the Sportster MPEM is roughly half the Speedster MPEM, actually the starboard (RH) portion.

○ **NOTE :** On occasion a component will statically check good but in fact be defective. In this instance, removing the original part and replacing it with a known good part is the most accurate procedure.

The MPEM (Multi-Purpose Electronic Module) is part of the ignition system as well as part of electrical system. This section gives testing procedure for ignition-related problems. For other type of problems, refer to MPEM section.

▼ **CAUTION :** Whenever replacing a component in ignition system, check ignition timing.

Spark occurrence can be checked with a tester from Superex Canada Ltd P / N 15-785.

To perform verifications, a good quality multimeter such as Fluke 73 (P / N 529 022 000) can be used.

When dealing with ignition problems, the following items should be checked in this order :

1. Spark occurrence / spark plug condition.
2. Battery condition.
3. MPEM supply fuse condition.
4. Electrical connections.
5. Engine stop / safety lanyard
6. MPEM
7. Magneto output.
8. Ignition coil output.

The first 5 items can be checked with common automotive equipment. For item 6, refer to MPEM section. For items 7 and 8, refer to the following procedures.

MPEM (Multi-Purpose Electronic Module)

ENGINE RPM LIMITER

On **Speedster** model, there is one RPM limiter for each engine in the MPEM.

A defective RPM limiter may cause the following problems :

- No spark.
- Misfiring / black fouled spark plugs.
- Uninterrupted spark when engine stop / safety lanyard / ignition switch is used.
- Incorrectly controlled engine maximum RPM.

To diagnose spark problems that might come from the MPEM, first check that its BLACK wire is perfectly grounded, then if there is no spark, temporarily bypass the RPM limiter by disconnecting the BLACK / RED /GREEN wire coming from engine magneto system. If everything now works normally, the RPM limiter is defective and the MPEM must be replaced.

○ **NOTE :** The **Speedster** has an additional BLACK /RED wire for port (LH) side engine. Each engine has its own RPM limiter circuitry inside the MPEM.

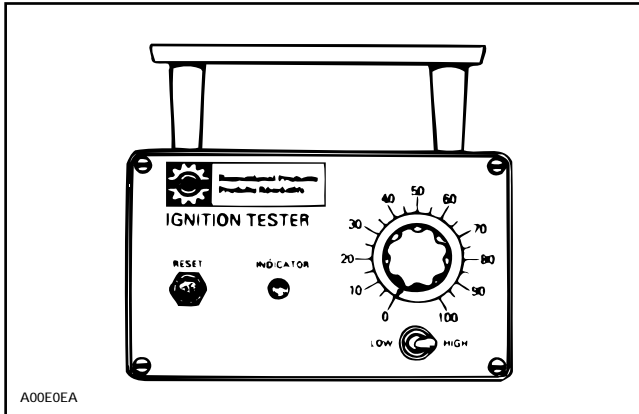
If engine does not stop when using stop / safety lanyard / ignition switch, ensure that BLACK / RED /GREEN (additional BLACK / RED wire on Speedster) wire is well connected to MPEM, check operation of all switches and if everything test good, the MPEM is defective and must be replaced.

To check engine RPM limitation function, run engine with shifter in forward or reverse position and check its maximum speed. It should be around 7000 RPM. Otherwise, the RPM limiter is defective and the MPEM must be replaced.

If the engine maximum speed does not go over 3500 RPM, the problem might come from the neutral switch. Refer to MPEM section.

Magneto / Ignition Coil Output Tests

These items can be easily checked with Bombardier ignition tester (P / N 295 000 008) and the 4-pin magneto test harness (P / 295 000 131).



For more information concerning operation and maintenance of the tester, refer to its instruction manual.

USE OF BOMBARDIER IGNITION TESTER

This tester can verify generating coil, ignition module, ignition coil and battery charging coil.

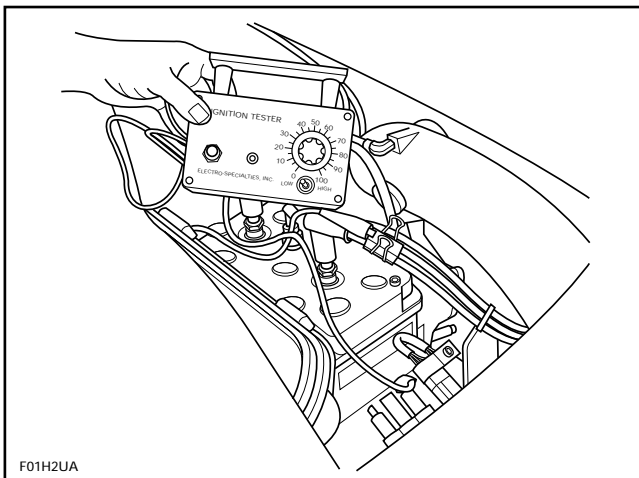
Always make sure that tester batteries are in good condition.

TEST CONDITION

All tests are performed on boat at cranking speed with spark plugs installed.

Always proceed in the following order :

1. Connect tester P and N clip leads as indicated for each specific test.



TYPICAL

2. Follow test procedure sequence.

3. Install cap over safety lanyard post and depress starting button until light turns on, or otherwise, for a maximum of 5 seconds.
4. If engine starts when performing some test, allow it to idle while observing indicator. Then, shut engine off.
5. After every test that lights the indicator lamp, RESET the indicator circuit by depressing the reset button.

ANALYSIS OF TEST RESULT

Indicator Lamp Lights at Specific Setting

Output is as specified. Test results should repeat 3 times. If readings do not repeat, output is erratic and cause should be investigated (loose connections or components, etc.).

Indicator Lamp Lights at Lower Setting

This indicates that the output is less than that designed to operate in a satisfactory manner. However, before coming to the conclusion of a faulty condition be certain that correct engine cranking conditions were met before condemning the tested part.

Indicator Lamp Does Not Light

One component is defective. Proceed as instructed to find defective component.

Intermittent Ignition Problems

In dealing with intermittent problems there is no easy diagnosis. For example, problems that occur only at normal engine operating temperature have to be tested under similar conditions.

In most cases of temperature and / or vibration failure, only parts replacement can solve the problem as most of these failures return to normal when engine is not running.

Multiple Problems

There is always the possibility of more than one faulty part. If after a component has been replaced, the problem still persists, carefully repeat the complete test procedure to find the other faulty part.

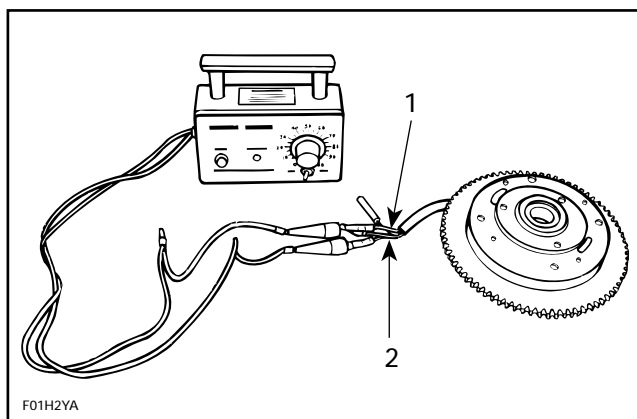
Safety Precautions

◆ **WARNING :** To prevent powerful electric shocks while cranking engine, neither touch any electronic ignition components (ignition coil, high tension wire, wire harness, etc.) nor tester lead clips. Also make sure that tester leads do not touch any metallic object. Ventilate bilge at least 2 minutes prior to performing any test.

Ignition System Generator Coil Output

1. Unplug magneto connector at engine. Connect the 4-pin magneto test harness (P / N 295 000 131) between the unplugged connectors.
2. Connect tester wires then set switch and dial as follows :

Tester wires	Component wires	Tester switch position	Tester dial position
N	BLACK / RED of magneto harness	LOW	85
P	BLACK of magneto harness		



TYPICAL

1. BLACK / RED
2. BLACK

3. Start engine and observe indicator.
4. Push reset button and repeat step 3 twice.

RESULTS :

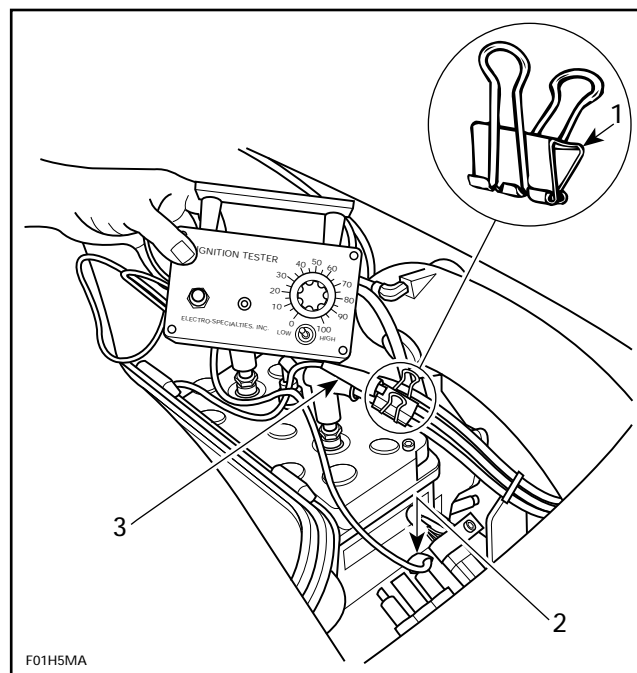
- a. **Indicator lamp lights :** Ignition system generator coil output is up to specifications.
- b. **Indicator lamp does not light :** The problem is a faulty ignition system generator coil. Replace it.

Ignition Coil Output

A paper clip of approximately 20 mm (3/4 in) will be used as a test adapter for the following test.

1. Install the test adapter to spark plug cable close to MAG side spark plug.
2. Connect tester wires then set switch and dial as follows :

Tester wires	Component wires	Tester switch position	Tester dial position
N	Tester adapter (paper clip) on spark plug cable	LOW	35
P	Engine ground		



TYPICAL

1. Paper clip
2. P lead to GROUND
3. N lead on spark plug cable

3. Start engine and observe indicator.

○ **NOTE :** If engine starts, allow it to idle while observing indicator. Then, shut engine off.

4. Push reset button and repeat step 3 twice.

RESULTS :

- a. **Indicator lamp lights :** Ignition coil is OK.
- b. **Indicator lamp does not light on one or both cylinder(s) :** Ignition coil is faulty. Replace it.

Section 08 ELECTRICAL

Sub-Section 03 (IGNITION SYSTEM)

Summary Table for Bombardier Ignition Tester

Test to perform	Tester wires	Component wires	Switch	Dial
Ignition system generator coil output	N	BLACK / RED of magneto harness	LOW	85
	P	BLACK of magneto harness		
Ignition coil output	N	Tester adapter on MAG spark plug cable	LOW	35
	P	Engine ground		

Ignition System Components Resistance Measurement

As an alternate method, ignition components can be checked with an ohmmeter (preferably a digital one). Proceeding by elimination, check ignition system generator coil then ignition coil / ignition module.

NOTE : CDI module is part of ignition coil and therefore, there is no probe point to specifically test primary winding of ignition coil. Only the secondary winding can be measured.

Disconnect connectors at ignition coil and magneto connector at engine. Connect the 4-pin magneto test harness (P / N 295 000131) at the engine. Do not connect the other end at the boat's harness. Check resistance between each terminal with a high-sensitivity ohmmeter. Refer to the following table for values and wire colors.

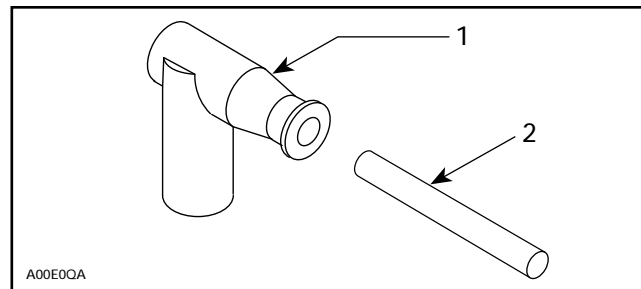
NOTE : An ignition coil with good resistance measurement can still be faulty. Voltage leak can occur at high voltage level which is not detectable with an ohmmeter.

MAGNETO		
PART NAME	WIRE COLOR	RESISTANCE (OHM) (Ω)
Ignition system generator coil	BLACK with BLACK / RED	40-76

IGNITION COIL		
PART NAME	WIRE COLOR	RESISTANCE (OHM) (Ω)
Secondary winding	End of each spark plug cable, spark plug caps removed	9-15 k

NOTE : A short circuit will read 0 ohm (or close to) on ohmmeter.

The spark plug caps must be removed from high tension cables, because they are resistor caps. The cap resistance is 4.5-5.5 K ohms.



1. Resistor cap
2. High-tension cable

IGNITION TIMING, 717 ENGINE

This section is mainly divided in 2 parts, the first one using a top dead center (TDC) gauge to verify PTO Flywheel Timing Mark Position. The second one using a stroboscopic timing light to check Ignition Timing.

Flywheel timing mark position verification is required to :

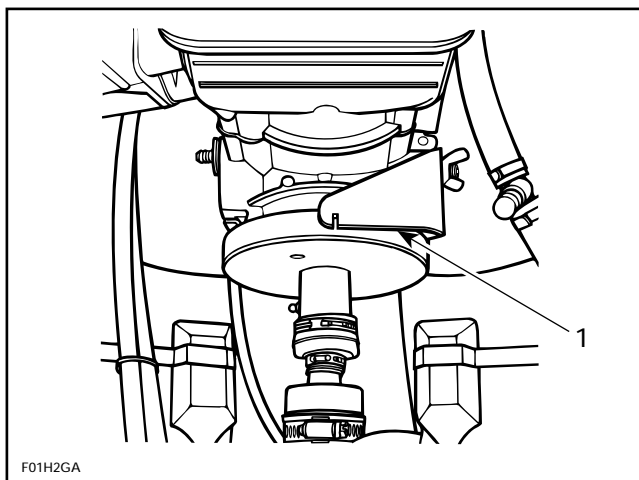
1. Troubleshoot a missing or broken magneto flywheel woodruff key.
2. Troubleshoot a magneto flywheel corresponding to a different engine type.
3. Scribe the timing mark on a new service PTO flywheel.

Always verify PTO flywheel timing mark position before checking ignition timing.

Verifying PTO Flywheel Timing Mark Position

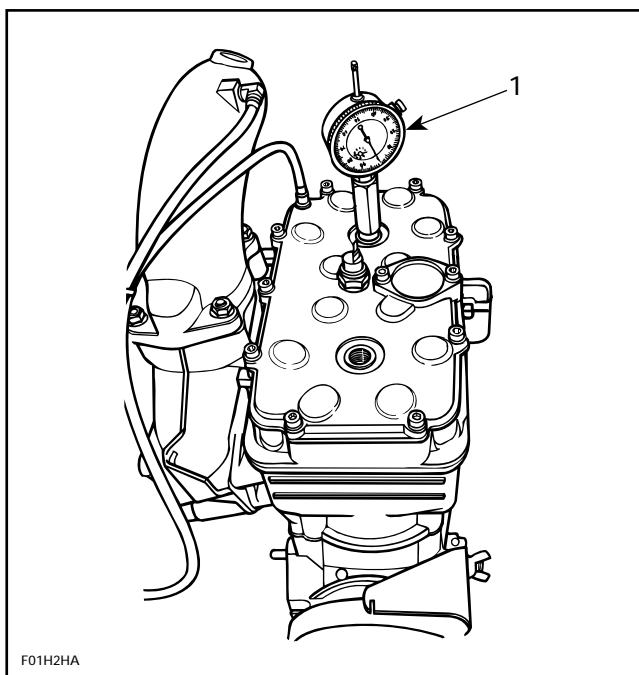
1. Disconnect MAG side spark plug wire and connect wire to grounding device then remove spark plug.
2. Remove PTO flywheel guard.

3. Install timing mark tool (P / N 295 000 130) on engine right side using wing nut previously removed.



1. Timing mark tool

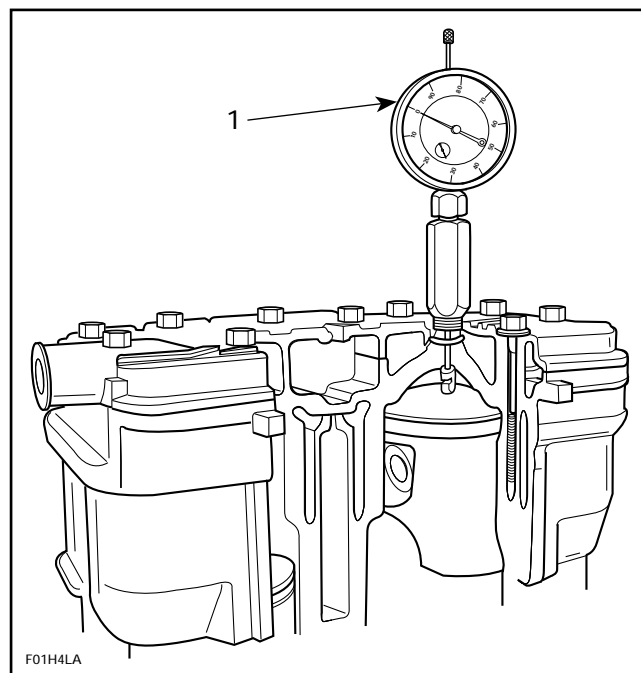
4. Install and adjust a TDC gauge (P / N 295 000 143) in spark plug hole as follows :



TYPICAL

1. TDC gauge on MAG side

Rotate PTO flywheel counterclockwise (when facing it) until piston is just before top dead center.



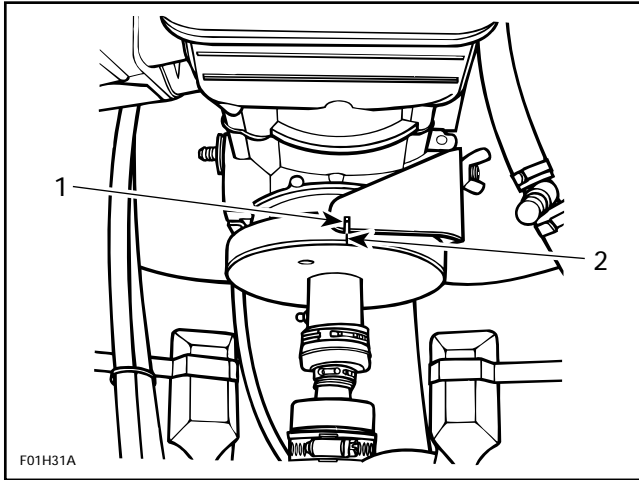
TYPICAL

1. Adjust gauge dial at zero

- Loosen adapter lock nut then holding gauge with dial facing toward PTO, screw adapter in spark plug hole.
 - Slide gauge far enough into adapter to obtain a reading then finger tighten adapter lock nut.
 - Rotate PTO flywheel counterclockwise until piston is at Top Dead Center.
 - Unlock outer ring of dial and turn it until zero (0) on dial aligns with pointer.
 - Lock outer ring in position.
5. From this point, rotate flywheel back 1/4 turn then rotate it counterclockwise to reach 2.59 mm (.102 in).
6. Using timing tool slot as reference mark, scribe in middle of tool slot a mark onto PTO flywheel.

Section 08 ELECTRICAL

Sub-Section 03 (IGNITION SYSTEM)



1. Tool slot
2. Flywheel mark

This mark becomes the reference when using stroboscopic timing light.

▼ **CAUTION :** Timing mark position verification cannot be used as a timing procedure, therefore, always check the timing with a stroboscopic timing light at 6000 RPM after the marks have been checked.

Checking Ignition Timing

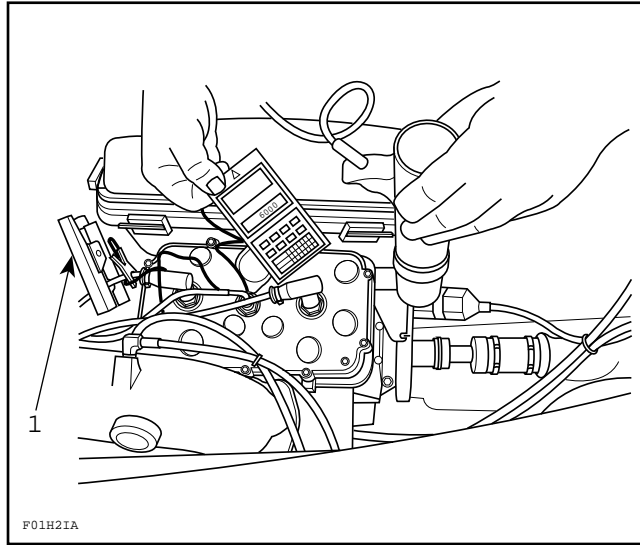
○ **NOTE :** To perform this procedure it is recommended to use a stroboscopic timing light rated to work up to 6000 RPM.

To check ignition timing, use a timing light (P / N 295 000 078).

○ **NOTE :** This timing light is battery powered (2 batteries, type C) and therefore needs no auxiliary power source.

The ignition components are affected by temperature variation, therefore, timing must be checked when engine is cold, after MAXIMUM 20 seconds idling

1. Connect timing light pick-up to MAG side spark plug lead.



TYPICAL

1. Timing light pick-up on MAG side

2. Connect an induction-type tachometer to spark plug wire.

3. Start engine and point timing light straight in line with timing tool slot. Bring engine to 6000 RPM for a brief instant.

IMPORTANT : Place shifter in forward or reverse position to allow engine reaching 6000 RPM.

○ **NOTE :** On this NIPPONDENSO system, timing advance decreases as engine speed increases. When marks are aligned at 6000 RPM, spark occurrence is still Before Top Dead Center.

4. Check if PTO flywheel mark (or reference one previously scribed) aligns with timing tool slot.

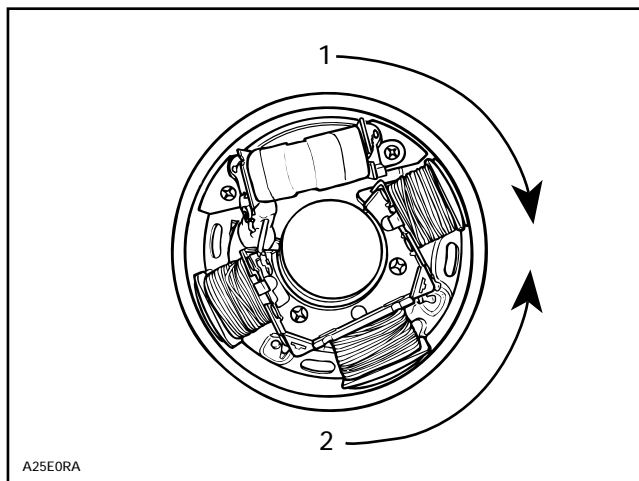
▼ **CAUTION :** If engine is to be run more than a few minutes, connect coupler hose (P / N 295 500 099) to properly cool engine.

If timing marks align, timing is correct.

▼ **CAUTION :** Always verify timing marks with TDC gauge before checking the timing. Particularly if PTO flywheel has been replaced, it could possibly move slightly.

IGNITION TIMING ADJUSTMENT, 717 ENGINE

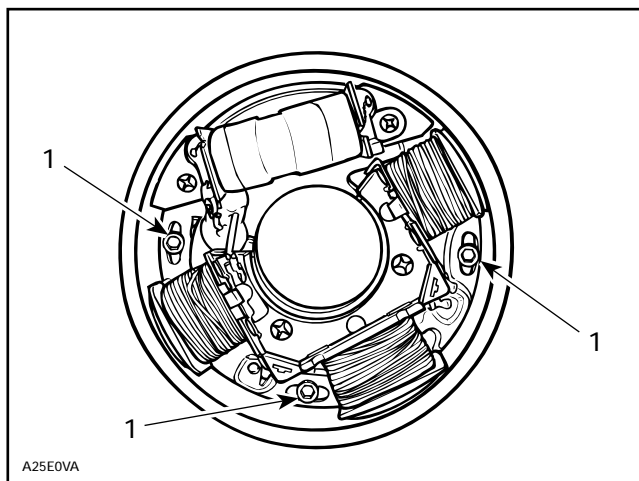
Timing is performed by moving armature plate, clockwise to retard spark occurrence or counterclockwise to advance.



TYPICAL

1. To retard
2. To advance

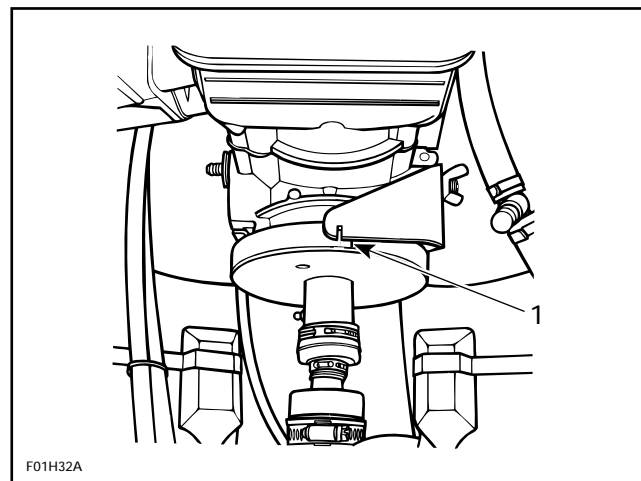
To adjust, loosen 3 armature plate retaining screws and slightly rotate armature plate in proper direction.



TYPICAL

1. Retaining screw

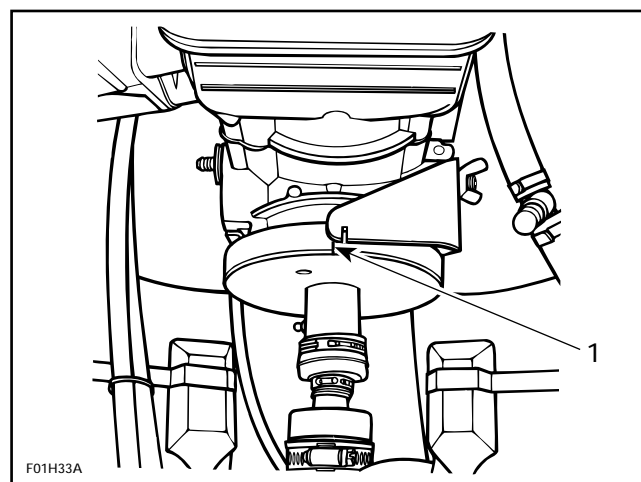
When PTO flywheel mark is on right side of timing tool slot, it indicates **advanced** timing.



1. Too advanced timing

In this case, turn armature plate clockwise.

When PTO flywheel mark is on left side of timing tool slot, it indicates retarded timing.



1. Retarded timing

In this case, turn armature plate counterclockwise.

After adjustment, tighten armature plate retaining screws.


CAUTION : Armature plate screws must have Loctite 242 (blue) applied before tightening. Make sure armature plate screws are well secured.

Reinstall removed parts.


Recheck ignition timing (make sure engine is cold).

IGNITION SYSTEM TESTING PROCEDURE, 787 ENGINE

General

 **NOTE :** On occasion a component will statically check good but in fact be defective. In this instance, removing the original part and replacing it with a known good part is the most accurate procedure.

The MPEM (Multi-Purpose Electronic Module) is part of the ignition system as well as part of electrical system. This section gives testing procedure for ignition-related problems. For other type of problems, refer to MPEM section.

 **CAUTION :** Whenever replacing a component in ignition system, check ignition timing.

Spark occurrence can be checked with a tester from Superex Canada Ltd P / N 15-785.

To perform verifications, a good quality multimeter such as Fluke 73 (P / N 529 022 000) can be used.

When dealing with ignition problems, the following items should be checked in this order :

1. Spark occurrence / spark plug condition.
2. Battery condition.
3. MPEM supply fuse condition.
4. Electrical connections.
5. Engine stop / safety lanyard
6. MPEM
7. DC-CDI module
8. Magneto output.
9. Ignition coil output.

The first 5 items can be checked with common automotive equipment. For item 6, refer to MPEM section. For items 7,8 and 9, refer to the following procedures.

MPEM (Multi-Purpose Electronic Module)

ENGINE RPM LIMITER

A defective RPM limiter may cause the following problems :

- No spark.
- Misfiring / black fouled spark plugs.
- Uninterrupted spark when engine stop / safety lanyard / ignition switch is used.

- Incorrectly controlled engine maximum RPM.

To diagnose spark problems that might come from the MPEM, first check that its BLACK wire is perfectly grounded, then if there is no spark, temporarily bypass the RPM limiter by disconnecting the BLACK / RED /GREEN wire coming from engine magneto system. If everything now works normally, the RPM limiter is defective and the MPEM must be replaced.

If engine does not stop when using stop / safety lanyard / ignition switch, ensure that BLACK / RED /GREEN wire is well connected to MPEM, check operation of all switches and if everything test good, the MPEM is defective and must be replaced.

To check engine RPM limitation function, run engine with shifter in forward or reverse position and check its maximum speed. It should be around 7200

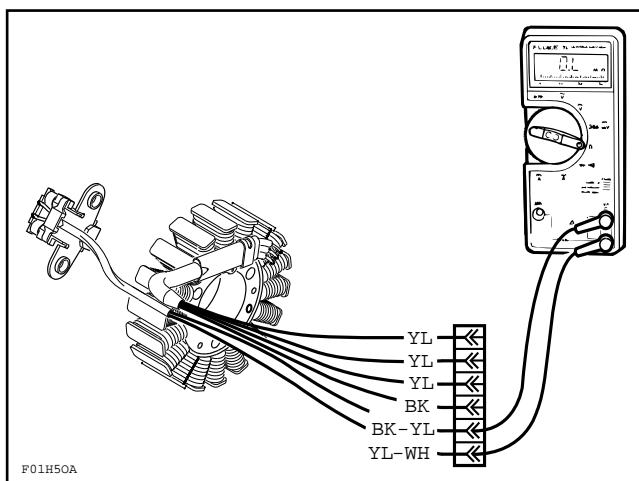
RPM. Otherwise, the RPM limiter is defective and the MPEM must be replaced.

If the engine maximum speed does not go over 3500 RPM, the problem might come from the neutral switch. Refer to MPEM section.

Trigger Coil

STATIC TEST : CONTINUITY

1. Disconnect the stator / trigger coil plug at the engine magneto cover. Connect the 6-pin magneto test harness (P / N 295 000 136) at the engine. DO NOT connect the other end at the boat's harness.
2. Connect the multimeter leads as shown (BK / YL to one meter lead, YL / WH to the other lead). Resistance should be approximately 242 ohms ($\pm 10\%$).



TYPICAL

NOTE : The trigger coil encompasses a small permanent magnet. Using a medium sized common screwdriver in the proximity of the magnet, verify magnetism is present (magneto cover removed).

DC-CDI Module

WIRE COLOR	FUNCTION
RE / PU	CDI Power source from MPEM
BK	Ground
WH	To ignition coil
YL / WH	Impluse from trigger coil
BK / OR	Blanks-not used at this time
BK / GR	Blanks-not used at this time
BK	Ground between DC-CDI and MPEM
GY / WH	RPM data to MPEM
WH / BL	Data to MPEM (low voltage)

STATIC TEST : CONTINUITY

+ Meter Lead	- Meter Lead	Value
RE / PU	BK	2.6 K Ω
YL / WH	BK	0.380 M Ω
WH	BK	2.208 M Ω
BK / OR	BK	infinity
BK / GR	BK	infinity
BK	BK	0.2 Ω
WH / BL	BK	30.38 K Ω
BK	RE / PU	2.690 K Ω
BK	YL / WH	0.390 M Ω
BK	WH	2.2 M Ω
BK	BK / OR	infinity
BK	BK / GR	infinity
BK	BK	2.69 K Ω
BK	GY / WH	33.07 K Ω

Ignition Coil

STATIC TEST : CONTINUITY

Primary Winding

1. Remove the 2 female spade connectors from the primary side of the ignition coil.
2. With the meter set on the resistance scale, connect the meter leads to the primary terminals of the coil.
3. Resistance should be approximately .3-.6 ohm.

Secondary Winding

1. With the ignition coil electrically isolated from the rest of the system, remove the spark plug caps from the ends of the high tension leads.
2. The meter function should be on resistance, connect the meter leads to the spark plug leads of the MAG and PTO cylinders, and your resistance should be 12.71K ohms ($\pm 10\%$).
3. Lastly, check resistance of spark plug caps. Install a meter lead where the high tension wire normally goes and the other meter lead where the spark plug connects. A reading of 4.5 to 5.5K ohms is normal.

DYNAMIC TEST

Test can be performed with either the Bombardier ignition tester (P / N 295 000 008) OR the KOWA ignition coil tester (typical), available from after market tool / equipment suppliers.

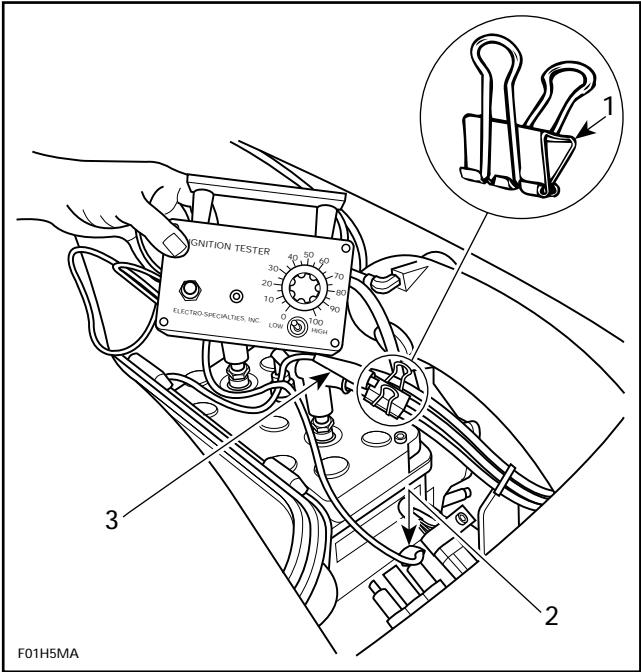
Testing with the Bombardier Ignition Tester

For more information how to perform the test and interpret the results, refer to "USE OF BOMBARDIER IGNITION TESTER" earlier in the 717 engine section.

A paper clip of approximately 20 mm (3/4 in) will be used as a test adapter for the following test.

1. Install the test adapter to spark plug cable close to MAG side spark plug. Unplug magneto connector at engine. Connect the 6-pin magneto test harness (P / N 295 000 136) between the unplugged connectors.
2. Connect tester wires then set switch and dial as follows :

Tester wires	Component wires	Tester switch position	Tester dial position
N	Tester adapter (paper clip) on spark plug cable	LOW	35
P	Engine ground		



TYPICAL

1. Paper clip
2. P lead to GROUND
3. N lead on spark plug cable

3. Start engine and observe indicator.

NOTE : If engine starts, allow it to idle while observing indicator. Then, shut engine off.

4. Push reset button and repeat step 3 twice.

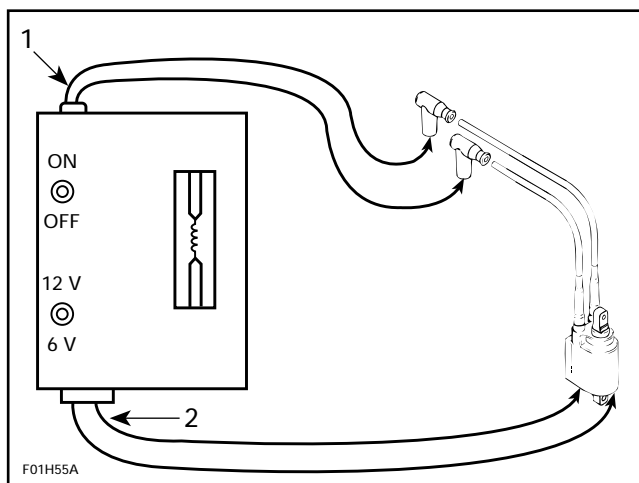
RESULTS :

- a. Indicator lamp lights : Ignition coil is OK.
- b. Indicator lamp does not light on one or both cylinder(s) : Repeat the test 3 times to get conclusive results. Ignition coil is faulty. Replace it.

Testing with the KOWA ignition coil tester

WARNING : Do NOT use coil tester on metal work bench. Follow manufacturer instructions.

1. With ignition coil removed from craft, disconnect spark plug caps from high tension leads.
2. Hook high tension leads from tester to ignition coil high tension leads.
3. Connect 2 smaller tester leads to primary of ignition coil.



TYPICAL

1. Leads to secondary
2. Leads to primary

4. Turn power switch to 12 volts and you should observe spark jumping at a predetermined gap of 7 to 8 mm (.276 to .311 in).

If there is no spark, if it is weak or intermittent, the coil is defective and should be replaced.

5. Observe tester operating time recommendations, usually about 5 minutes per coil is sufficient.

IGNITION TIMING, 787 ENGINE

Overview

Normally ignition timing adjustment should not be required. It has been set at factory and it should remain correctly adjusted since every part is fixed and is not adjustable. The only time the ignition timing might have to be changed would be when replacing the crankshaft, the magneto flywheel, the trigger coil, the Nippondenso DC-CDI module or the MPEM. If the ignition timing is found incorrect, you should first check for proper crankshaft alignment. This might be the indication of a twisted crankshaft.

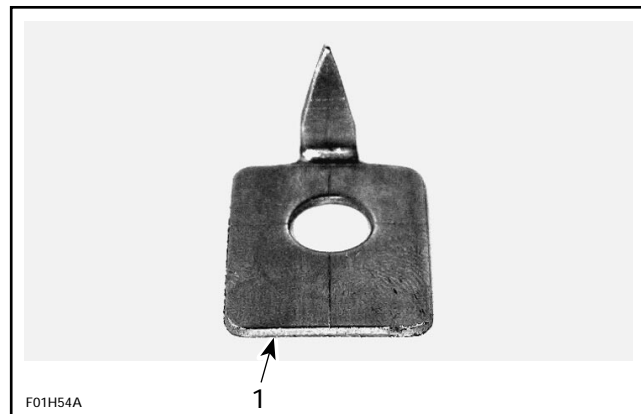
With this new CDI system, the ignition timing can be checked with either the engine hot or cold. Besides the **ignition timing is to be checked at 3500 RPM** with the timing light.

Within 3000 and 4000 RPM, the spark advance does not change. So when checking timing at 3500 RPM, a change in engine speed within ± 500 RPM will not affect the timing mark when checked with the timing light.

Ignition Timing Procedure

STATIC TEST

1. To install the new timing mark pointer tool, first remove PTO flywheel guard. Then remove middle screw securing the engine to the rear cross-over motor mount. Reinstall screw with timing mark pointer tool attached.



1. Timing mark pointer tool (P / N 295 000 135)

2. Install a TDC gauge in MAG side spark plug hole. Rotate PTO flywheel until piston is at top dead center.
3. From this point, rotate flywheel clockwise (when facing it) until piston is at 3.38 mm (.133 in) before top dead center.
4. Scribe a mark on PTO flywheel aligned with timing mark pointer tool.
5. Remove TDC gauge, reinstall spark plug and connect wire.

DYNAMIC TEST

1. Connect an induction-type tachometer (P / N 295 000 100) to spark plug wire.
2. Check ignition timing using a stroboscopic timing light connected to the MAG side spark plug cable. Rev the engine to 3500 RPM and point beam of timing light straight in line with timing mark pointer.

CAUTION : If engine is to be run more than a few seconds, connect a garden hose and supply water to the engine to properly cool it.

NOTE : If mark on PTO flywheel is perfectly aligned with timing mark pointer, no adjustment is required. If it is not the case, refer to the following procedure.

Ignition Timing Adjustment

Since the trigger coil on this engine is fixed and not movable to correct the ignition timing, the MPEM programmer (P / N 295 000 127) is now used to set the timing when an adjustment is required. The programmer will act as if you were moving the trigger coil to advance or retard the ignition timing.

Through the MPEM programmer, the ignition timing can be advanced up to 3° or retarded up to 4°. If the timing is adjusted too retarded, a performance decrease of the engine will be noticed. If the timing is adjusted too advanced, serious engine damage will occur.

▼ **CAUTION :** If the ignition timing is adjusted too advanced, this will cause serious damage to the engine.

THE TIMING CORRECTION CHART

The timing marks refer to the physical component position when the spark must occur. The DC-CDI module must be synchronized with these marks. The timing correction just do that. For instance, on a particular engine, the timing correction may need to be advanced to 2° so that the marks align. This is not the real spark advance, just a correction for the tolerances of the mechanical components.

A timing light is still used to check the marks alignment. If the marks are found aligned, the ignition timing is correct and no further action is required.

If the marks are found misaligned, the ignition timing must be corrected. When using the programmer, it will give you the actual correction number that is programmed inside the MPEM. Referring to the chart below, find the corresponding degree and if the correction was made to advance or retard the timing.

Knowing that, you select the higher or lower number to advance or retard the actual timing correction by referring to the chart.

TIMING CORRECTION CHART	Advanced				Retarded			
Number from the programmer (read from MPEM)	2	3	4	1	5	6	7	8
Correction of ignition timing in degrees	3°	2°	1°	0	-1°	-2°	-3°	-4°

Simply put, you just have to change the number the programmer gave to have the timing marks aligned. If the flywheel mark goes in the bad direction after you tried the neighbor value given by the programmer, try the other neighbor value to move the mark in the opposite direction. E.g.: the programmer gave no. 3. You tried no. 4 and the flywheel mark moved in the wrong direction, try the no. 2.

Examples :

- a. You found the flywheel mark advanced. You must retard the timing.
 - The programmer gives you the number 3. Referring to the chart, number 3 returns 2°. The timing correction is actually set at 2° (advanced) and this is too much.
 - You estimate the correction should be set to 1° (advanced) to retard flywheel mark so that the timing marks align. Back in the chart, look to find 1° (advanced). This gives number 4. Enter this number with the programmer.
 - You recheck the marks with the timing light and they are now aligned. The adjustment is finished.

- b. You found the flywheel mark advanced. You must retard the timing.
 - The programmer gives you the number 3. Referring to the chart, number 3 returns 2°. The timing correction is actually set at 2° (advanced) and this is too much.
 - You estimate the correction should be set to 1° (advanced) to retard flywheel mark so that the timing marks align. Back in the chart, look to find 1° (advanced). This gives number 4. Enter this number with the programmer.

- You recheck the marks with the timing light and found that the flywheel mark is still too advanced. You know now that the correction made previously was not enough and you estimate the correction should be set to 2° (retarded) to retard flywheel mark more. Back in the chart, look to find 2° (retarded). This gives number 6. Enter this number with the programmer.
- You recheck the marks with the timing light and they are now aligned. The adjustment is finished.
- c. You found the flywheel mark retarded. You must advance the timing.
 - The programmer gives you the number 4. Referring to the chart, number 4 returns 1°. The timing correction is actually set at 1° (advanced) and this is too much.
 - You estimate the correction should be set to 2° (advanced) to advance flywheel mark so that the timing marks align. Back in the chart, look to find 2° (advanced). This gives number 3. Enter this number with the programmer.
 - You recheck the marks with the timing light and they are now aligned. The adjustment is finished.

Adjusting the Ignition Timing with the Programmer

1. Connect the communication cable to the MPEM programmer and the other end to the safety lanyard post on the craft.
2. Press the **ON / C** button on programmer and enter you password.
3. Press **3** to choose **Vehicle info** in programmer.
4. Press **4** to choose **Engine param.**
5. Press **2** to choose **Timing adjust.**
6. The programmer display a number that is actually stored in the MPEM.
7. Press **__** to choose **yes** for **modify** then press **Enter**.
8. Now punch in the number that corresponds to the degree you want for the ignition timing then press **Enter**.
9. Press **Menu** to go back one level.
10. Press **8** to choose **Save + Quit** (even if item no. 8 is not visible on the display, it is active when you select it).


11. Press **Enter** to confirm yes you want to **save modifications** to the MPEM.

12. You must see **Operation successful**. This confirms that the new timing has been stored in the MPEM.

13. Unplug communication cable from safety lanyard post on craft.

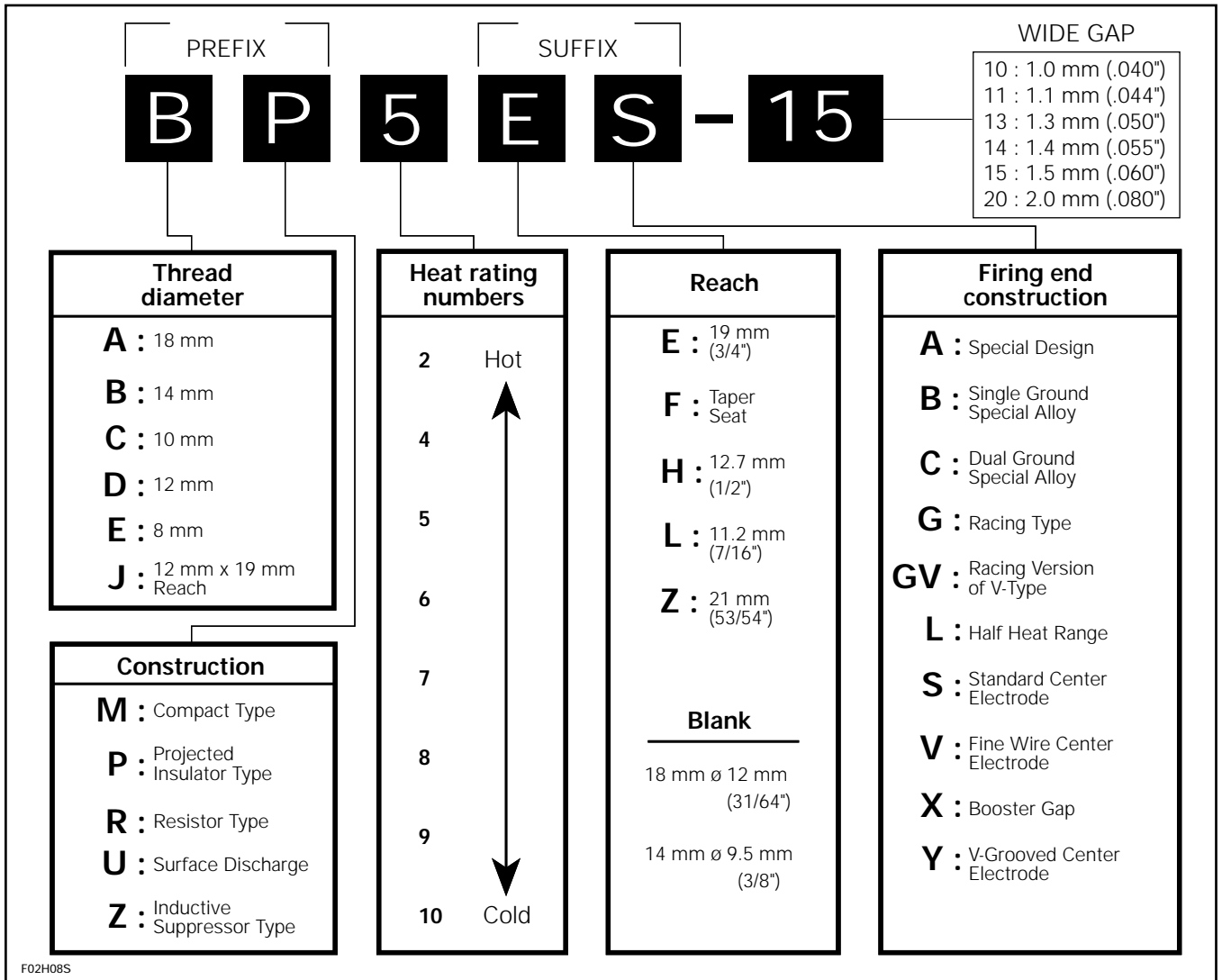
At this point, you can install the craft's safety lanyard and start the engine to check the effect of the correction on the timing marks. If further adjustment is required, repeat the procedure.

14. Press Off to close the programmer.

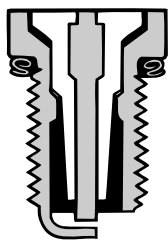
 **NOTE :** The MPEM module features a permanent (non-volatile) memory and keeps the ignition timing programmed even when the craft's battery is disconnected.

SPARK PLUGS

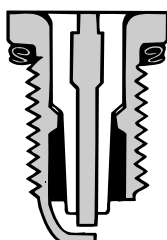
SPARK PLUG SYMBOL EXPLANATION



CROSSCUTS AND GAP STYLES OF SPARK PLUGS



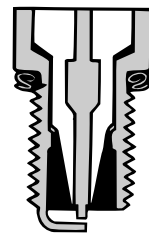
Standard Type



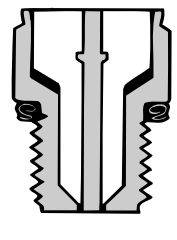
Projected Insulator Type



Taper Seat Type



V-Type



Surface Discharge Type

A01E1PS

DISASSEMBLY

First unscrew the spark plug one turn.

Clean the spark plug and cylinder head with pressurize air then completely unscrew.

HEAT RANGE

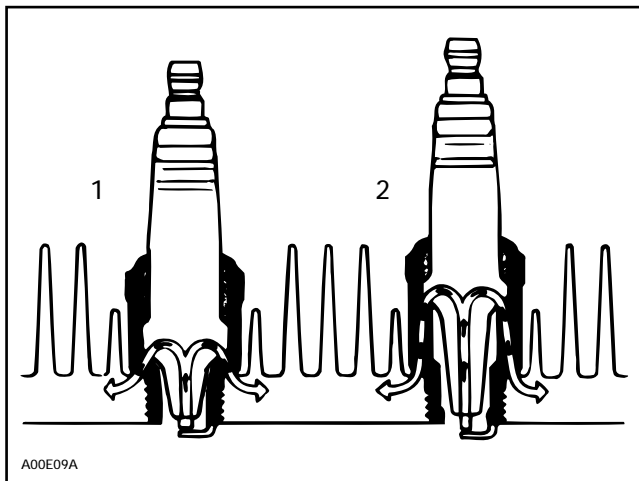
The proper heat range of the spark plugs is determined by the spark plugs ability to dissipate the heat generated by combustion.

The longer the heat path between the electrode tip to the plug shell, the hotter the spark plug operating temperature will be – and inversely, the shorter the heat path, the colder the operating temperature will be.

A “cold” type plug has a relatively short insulator nose and transfers heat very rapidly into the cylinder head.

Such a plug is used in heavy duty or continuous high speed operation to avoid overheating.

The “hot” type plug has a longer insulator nose and transfers heat more slowly away from its firing end. It runs hotter and burns off combustion deposits which might tend to foul the plug during prolonged idle or low speed operation.



1. Cold
2. Hot

▼ **CAUTION :** Severe engine damage might occur if a wrong heat range plug is used.

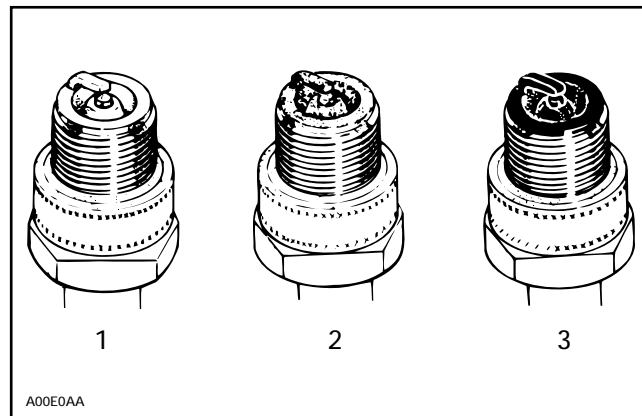
A too “hot” plug will result in overheating and pre-ignition, etc.

A too “cold” plug will result in fouling (shorting the spark plug) or may create carbon build up which can heat up red-hot and cause pre-ignition or detonation.

FOULING

Fouling of the spark plug is indicated by irregular running of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption. This is due to a loss of compression. Other possible causes are : prolonged idling, or running on a too rich mixture due to a faulty carburetor adjustment or incorrect fuel. The plug face of a fouled spark plug has either a dry coating of soot or an oily, glossy coating given by an excess either of oil or of oil with soot. Such coatings form a conductive connection between the center electrode and ground.

SPARK PLUG ANALYSIS



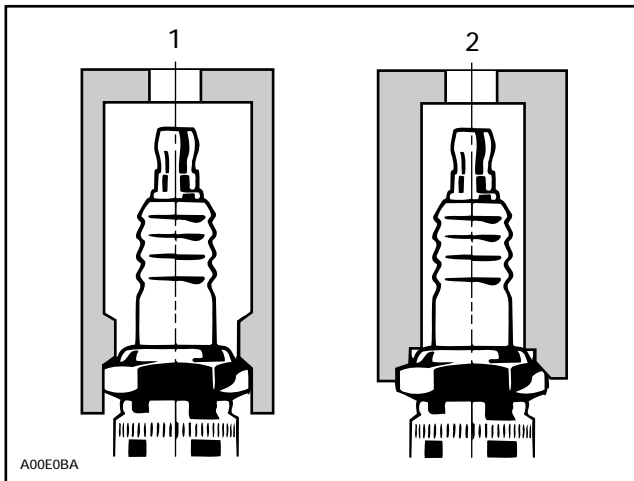
1. Overheated (light grey)
2. Normal (brownish)
3. Fouled (black)

The plug face (and piston dome) reveals the condition of the engine, operating condition, method of driving and fuel mixture. For this reason it is advisable to inspect the spark plug at regular intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber) and the piston dome.

SPARK PLUG INSTALLATION

Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, set electrode gap according to the following chart.
2. Apply anti-seize lubricant over the spark plug threads to prevent possible seizure.
3. Hand screw spark plug into cylinder head and tighten with a torque wrench and a proper socket.



1. Proper socket
2. Improper socket

SPARK PLUG CHART

Engine type	Spark plugs	Torque N•m (lbf•ft)	Gap mm (inch)
All	NGK BR8ES	24 (17)	0.55 (.022)

THE DESS (DIGITALLY ENCODED SECURITY SYSTEM)

SAFETY LANYARD

The basic operation of the DESS safety lanyard is the same as other types. It must be installed on the boat's DESS post to allow engine starting and you pull it to stop the engine.

After stopping the engine with the start / stop button while the safety lanyard remains on the DESS post, it can be restarted as usual within approximately 10 minutes by pressing again the start / stop button. After this delay, it may be necessary to push and turn the safety lanyard on the DESS post until 2 short beeps are heard to indicate the system is ready to allow engine starting.

◆ **WARNING :** While the boat's engine can be stopped using the start / stop button, good driving habits recommend that the safety lanyard also be disconnected when stopping.

PROGRAMMING OF SAFETY LANYARD(S)

You must use the MPEM programmer (P / N 295 000 127). Refer to its guide for proper use.

FEATURES OF THE DESS

The DESS comprises the MPEM (Multi-Purpose Electronic Module) purposely designed for, a DESS post and a cap that contains both a magnet and a ROM chip. This system allows an anti-start protection against unauthorized use of the boat. The DESS safety lanyard cap specifically contains an electronic circuit that gives it a unique digital serial number so no other lanyard can be used (unless otherwise programmed). Other type of non DESS safety lanyard will not work on a DESS system.

At least one safety lanyard must be programmed to operate a boat. At this point, only this lanyard allows starting the engine on this particular boat which has been programmed to recognize only this safety lanyard. This safety lanyard can not be used on another boat and conversely, the one from another boat can not be used on your boat unless otherwise programmed as explained below.

○ **NOTE :** Technically, the boat's MPEM is the component that is actually programmed to recognize a safety lanyard. The MPEM stores the digital serial number from the safety lanyard cap in its memory. However, for the sake of clarity, we will refer to "safety lanyard programming" in the following technical discussions.

However, the DESS brings a great flexibility. You can sell additional lanyard(s) and program it(them) to a boat so that more than one lanyard can be usable on a particular boat. Up to 8 safety lanyards can be programmed to a boat. The same lanyard can not be programmed 2 times on a particular boat.

All of these lanyards can be programmed to a boat during the same programming session or thereafter is desired. The safety lanyards cumulate up to 8 in the MPEM's memory of the boat. If you add safety lanyard(s) and reach the 9th lanyard you will have the choice to keep the previous 8 lanyards or restart from the 1st and thus erasing all previous lanyards.

○ **NOTE :** If a customer sells his boat, you can permanently erase all lanyards that were programmed for the boat and program a new one for the new customer (remember at least one lanyard **MUST** be programmed in the boat's MPEM). Or, reprogram only the lanyards that the new customer wants.

You can program a lanyard to operate other boats (if equipped with the DESS). The same safety lanyard can be programmed to as many boats as desired.

Lanyard(s) programmed for other boats (if equipped with the DESS) can be used on your own boat when programmed for. When buying a new safety lanyard for the DESS from the factory, it can be used on any boat equipped with the DESS. At this point, it is only physically interchangeable and it will not allow engine starting unless programmed for. After it has been programmed to a boat, the lanyard will be the only one that allows engine starting (unless otherwise programmed as explained above).

Section 08 ELECTRICAL

Sub-Section 05 (THE DESS (DIGITALLY ENCODED SECURITY SYSTEM))


The boat MPEM features a permanent (non-volatile) memory and keeps programmed safety lanyard(s) active even when the boat's battery is disconnected.

When replacing an MPEM, reprogramming safety lanyard(s) is required.

MONITORING SYSTEM

To assist you when using the boat, a system monitors the DESS and sends audible signals through a beeper to warn you of a particular condition. It is self-activated when the safety lanyard is being installed on the boat's DESS post. It gives immediate monitoring. Some codes may occur only when pressing the start / stop button. Refer to the following chart.

NUMBER OF BEEPS	CAUSE	REMEDY
2 shorts (while installing safety lanyard on boat's DESS post)	<ul style="list-style-type: none"> Everything is correct with the safety lanyard (good contact and right lanyard cap). 	<ul style="list-style-type: none"> Engine can be started normally.
1 long (while installing safety lanyard on boat's DESS post or when pressing start / stop button in some cases)	<ul style="list-style-type: none"> Bad connection between safety lanyard cap and DESS post. Wrong safety lanyard. Salt water or dirt in safety lanyard cap. Improper operation of MPEM or defective wiring harness. 	<ul style="list-style-type: none"> Push and turn the safety lanyard on the DESS post until 2 shorts beeps are heard to indicate the system is ready to allow engine starting. Use the safety lanyard that has been programmed for the boat. If it does not work, check safety lanyard condition with the MPEM programmer. Replace safety lanyard if reported defective. If it still does not work, enable the advanced diagnostic mode to obtain more detail about the failure. Shake and / or clean safety lanyard cap to remove salt water / dirt. Enable advanced diagnostic mode to obtain more detail about the failure.
4 shorts (while pressing start / stop button with safety lanyard already installed).	<ul style="list-style-type: none"> Shifter is NOT in neutral. 	<ul style="list-style-type: none"> Place shifter in neutral. While moving the shifter, 1 short beep indicates you reached the neutral position.
1 short (while moving shifter to neutral).	<ul style="list-style-type: none"> Confirmation that shifter is now in neutral. 	<ul style="list-style-type: none"> Engine is now ready to be started.
4 longs (while installing safety lanyard on boat's DESS post).	<ul style="list-style-type: none"> Boat's MPEM can not communicate with the DC-CDI modules. (787 engine only). 	<ul style="list-style-type: none"> Check fuse on MPEM located in electrical box. Check connector between MPEM and DC-CDI modules.
8 shorts	<ul style="list-style-type: none"> Defective MPEM (memory) 	<ul style="list-style-type: none"> Replace MPEM.
Continuous	<ul style="list-style-type: none"> Engine overheating. 	<ul style="list-style-type: none"> Check connections and engine overheat sensor. If everything is correct, troubleshoot engine.

 **NOTE :** From these error codes, we can get more information by entering the advanced diagnostic mode. Refer below.

The Advanced Diagnostic Mode

It needs to be enabled manually. Proceed as follows :

Section 08 ELECTRICAL

Sub-Section 05 (THE DESS (DIGITALLY ENCODED SECURITY SYSTEM))

1. Remove safety lanyard from boat's DESS post and set shifter in NEUTRAL.
2. Press 5 times on the boat starting button.
 - 1 short beep and 1 long beep must be heard.
They validate beginning of diagnostic mode.
3. Install safety lanyard on boat's DESS post.
4. Press the boat's starting button again.
 - If everything is correct, engine will start. Otherwise, refer to the following chart.

ADVANCED DIAGNOSTIC MODE		
NUMBER OF BEEPS	CAUSE	REMEDY
No beep	<ul style="list-style-type: none">• Engine actually starts.	<ul style="list-style-type: none">• Everything is correct.
1 long and 1 short	<ul style="list-style-type: none">• No safety lanyard has ever been programmed in boat's MPEM.	<ul style="list-style-type: none">• Use programmer and program a safety lanyard. This code can occur only when you receive a new MPEM from the factory and no key has ever been programmed.
2 shorts	<ul style="list-style-type: none">• MPEM can not read the electronic circuit in safety lanyard or the magnet is defective in safety lanyard.• Mixed wires at DESS post connection of the DESS wires.	<ul style="list-style-type: none">• Check safety lanyard condition with the MPEM programmer. Replace safety lanyard if reported defective.• Check DESS post wiring harness.
2 longs	<ul style="list-style-type: none">• Wrong safety lanyard or bad connection of the DESS wires.	<ul style="list-style-type: none">• Use the safety lanyard that has been programmed for the boat. If it does not work, check safety lanyard condition with the MPEM programmer. Replace safety lanyard if reported defective. Check wiring harness connections.
3 shorts	<ul style="list-style-type: none">• Wiring harness of DESS post is grounded or there is a short circuit.	<ul style="list-style-type: none">• Check wiring harness and DESS post.

NOTES :

- If you need to listen again the coded beeps, remove safety lanyard and repeat the procedure to activate the diagnostic mode.
- If many problems are encountered, the MPEM will send only one error code. When the problem is solved, the MPEM will send a second code and so on until there is no problem.

MPEM

(multi-purpose electronic module)

NOTE : The following section gives information for both **Sportster** and **Speedster** models. To make the section shorter, the **Sportster** is actually described and the differences for the **Speedster** are added. Relative to the **Speedster**, the **Sportster** MPEM is roughly half the **Speedster** MPEM, actually the starboard (RH) portion.

OPERATION OF MPEM

Accessories

All accessories (bilge pump, blower, navigation lights, auxiliary supply) are directly supplied by the battery. These are protected by fuses located on the fuse block. The fuse block is protected by a separate fuse located in electrical box. Accessories can work with or without the safety lanyard and ignition key.

On Speedster, the accessories are connected to both batteries.

Safety Lanyard

This switch is activated by a cap. When cap is over the DESS post, the switch is electrically closed and engine can be started. When the cap is NOT over the DESS post, the switch is opened and engine can not be started.

On Speedster, pulling cap from DESS post stops both engines simultaneously when they are running.

33-Second Temporization

Activating the start / stop switch (any switch on **Speedster**) while the safety lanyard is NOT on DESS post will give access to temporization mode. When in temporization mode, the MPEM gauges outlet (PURPLE, PURPLE / TAN and PURPLE / GREY wires) will be activated for 33 seconds. This provides 12 Vdc to each gauge and to the monitoring beeper. Obviously, when in temporization mode, engine will not start. The main function of this mode is to read fuel level.

To Start Engine

Install safety lanyard on boat's DESS post. The MPEM will be energized instantly and will check the safety lanyard cap. If the lanyard is not programmed for the boat, the beeper emits one long beep. If it is programmed, the beeper emits 2 short beep and the gauges outlet will be activated for 33 seconds.

When pressing the start / stop switch (any switch on **Speedster**) while shifter lever is NOT in neutral position, beeper will emit 4 short beeps. To start engine, shifter lever must be in neutral position. A short beep while moving shifter confirms the right position.

When the safety lanyard cap is installed, AND that the shifter lever is in neutral position, engine starting is now allowed by pressing on the start / stop switch (any switch on **Speedster**).

When engine is running, the gauges outlet is activated. A signal from the magneto is sent to the MPEM in order to determine the engine's RPM. When in neutral, the engine's speed is limited to 3500 RPM. When in forward or in reverse, the engine's speed is limited to 7000 RPM.

On Speedster, each magneto sends the signal to the MPEM.

To Stop Engine

When engine runs above 1000 RPM, it is possible to stop it by pressing on the start / stop switch. If safety lanyard is removed from DESS post, engine will stop no matter what its RPM is. If the MPEM's ground wire is cut, engine will stop instantly.

On Speedster, each engine can be stopped individually by pressing the start / stop switch of the same side of the engine you want to stop. Removing the safety lanyard will stop both engines simultaneously.

RPM Limiter

It has 4 functions :

- Keeps high voltage away from safety lanyard switch.
- Provides engine stop by shorting the ignition system generator coil on **717 engine** and using the MPEM on the **787 engine**.
- Limits engine RPM to 3500 when shifter is in neutral position.
- Limits engine RPM to prevent overrevving at full throttle when in forward or reverse.

ELECTRICAL TESTS FOR THE MPEM

The following gives general electrical-related problems, for ignition problems, refer to IGNITION SYSTEM

08-03.

General

To ease working, the engine compartment cover may be removed. Also, the electrical box may be removed from its mounting location then laid flat on engine. For that, loose cable retaining nuts and pull cables out of electrical box.

Always use resistor type spark plugs, otherwise RFI (Radio Frequency Interference) might affect MPEM operation.

If there is an electrical problem, first check battery condition. Never use a battery charger to temporarily substitute the battery ; this might give erratic operation or no operation at all.

Check the MPEM supply fuse (2 on **Speedster**). Then, make sure to visually inspect all wirings, connections and fuse tightness.

Wire numbers and connector positions refer to wiring diagram.

When replacing a MPEM, always have battery(ies) disconnected.

Prior to replacing a MPEM, always check electrical connections. Disconnecting and reconnecting the MPEM may cure a "defective" module. The voltage and current may be too low to flow across dirty wire terminals. Carefully inspect terminals for moisture, corrosion or dull appearance. Clean properly then apply silicone dielectric grease when reassembling.

Speedster Only

- Both batteries must be properly connected. Never alter connections of batteries. They are connected in parallel.
- Electric systems are simply doubled, 2 ignition coils, 2 starting solenoids, 2 charging systems etc. Basically the components (ignition coil, rectifier / voltage regulator, starting solenoid etc.) located on one side belong to the engine of the same side (ex : ignition coil located on port side (LH) belongs to the port side engine).
- In the electrical system, basically the same wire colors are used for starboard (RH) and port (LH) sides. To differentiate sides, the starboard (RH) side wires have an additional GREEN tracer on the main wiring harness and on the MPEM.

All Models

IMPORTANT : The following troubleshooting procedures will apply if the problem is not due to one of the above items.

DESS Post

If it is impossible to stop engine with safety lanyard, check BLACK / RED / GREEN wire (additional BLACK /RED wire for port side (LH) of **Speedster**) connection first.

Disconnect DESS post connector behind dashboard to check its operation. Using an ohmmeter, take a resistance reading between BLACK and BLACK /YELLOW of DESS post wires. When safety lanyard cap is not over its post, the resistance reading should be greater than 20 MW. When cap is over post, the reading should be not greater than 1 W.

When safety lanyard cap is on its post, it is possible to check wiring continuity between positions no. N and no. dd of the electrical box connector. The wire position of the electrical box connector should also be checked. The BLACK / YELLOW wire from the MPEM is in position no. dd, and the BLACK wire, also from the MPEM, is in position no. N.

If the DESS system is not working, you can check the DESS wire as follow. Disconnect the connector behind dashboard. Measure the resistance between center post terminal and the WHITE / GREY wire. The reading should not be greater than 1 MW. Otherwise replace DESS post. the DESS system can be diagnosed with the beep codes.

○ **NOTE :** If DESS post removal is required, use the safety lanyard post tool (P / N 295 000 121).

Start / Stop Switch

The start / stop switch's configuration is a SPST NO (Single Pole, Single Throw, Normally Open) type. This means that the contact is open when the switch is not pressed. It is necessary to disconnect the switch connectors behind the dashboard to check the switch condition.

Take a resistance reading at the switch's terminals. When the switch is not pressed, resistance should be infinite. When the switch is activated, resistance should not exceed 1 W.

With the switch disconnected, check voltage in the harness where the switch is connected. Safety lanyard must be on DESS post. To do so, connect voltmeter's positive test probe to position A of weather pack. Voltmeter's negative test probe is connected to position B of weather pack. The voltmeter reading should be about 12 Vdc (battery voltage). If such is not the case, do as follows :

1. Disconnect harness from electrical box.
2. Using a voltmeter, take a reading between positions no. ee and no. 1 of the box connector. (On **Speedster**, work with additional no. and no. for port side (LH)). The reading must be 12 Vdc. If such is the case, the problem is related to the harness. Consequently, check the continuity of wire no. ee (additional no. for port side (LH) of **Speedster**).
Unplug the connector from the fuse block (in front storage compartment). Check the wire continuity at position no. 6 (additional no. for port side (LH) of **Speedster**).
3. If problem originates from the electrical box, check the condition of the MPEM supply fuse (2 on **Speedster**). Also check the wire condition in positions no. ee and no. 1 of connector (additional no. and no. for port side (LH) of **Speedster**).
4. If the start / stop switch still does not work, the MPEM can be suspected.

If the STOP function of the start / stop switch does not work, it is necessary to check if engine runs over 1000 RPM. If it does so, check the BLACK / RED / GREEN wire connection (additional BLACK / RED wire for port side (LH) of **Speedster**). If this does not solve the problem, the MPEM is faulty.

Starting Solenoid Activation

When engine does not start, the second item to check, after the start / stop switch, is the starting solenoid activation. When the start / stop switch is pressed with safety lanyard on DESS post, MPEM solenoid outlet YELLOW / RED / GREEN wire (additional YELLOW / RED for port side (LH) of **Speedster**) is activated and it provides a 12 Vdc voltage. In order to check this circuit, it is necessary to disconnect connector from solenoid. Ensure that there is 12 Vdc at the connector's terminals when start / stop switch is activated. If not, the MPEM can be the cause.

If everything tests good, check starting solenoid. Refer to STARTING SYSTEM 08-07.

Neutral Switch

When shifter lever is in neutral position, the neutral switch is electrically closed. Take a resistance reading at the switch's terminals. First remove connectors from switch. When the switch is not pressed, resistance should be infinite. When the switch is activated, resistance should not exceed 1 W. Reinstall connectors.

The MPEM's neutral inlet corresponds to RED / WHITE wire in position no. aa of electrical box connector. To check harness, disconnect it from the electrical box. Ensure wire continuity between positions no. aa and no. 1 of connector when shifter is in neutral. Also ensure that BLACK wire, in position no. 1, is perfectly grounded. Unplug the large connector from the fuse block (in front storage compartment). Check continuity of wire at position no. 5. If the problem is not solved, replace the MPEM.

○ **NOTE :** Vibration can cause a malfunction of the neutral position switch. Indeed, vibration causes contacts to shut off, which may bring about the engine not to run over 3500 RPM.

RPM Limiter

If maximum engine's speed is not limited to 7000 RPM, check the connection of BLACK / RED / GREEN wire (additional BLACK / RED wire for port (LH) side of Speedster). Otherwise, replace the MPEM.

Gauge Supply Outlet

Gauge supply, as well as beeper supply, come from the MPEM via a relay. If this outlet malfunctions, check the gauge fuse (on MPEM) first.

Measure the voltage between the gauge outlet and a ground (ensure ground is perfect). It should be 12 Vdc. Otherwise, the MPEM is faulty (possibly the gauge relay).

If gauge outlet supplies 12 Vdc, check the wire position of PURPLE, PURPLE / TAN and PURPLE / GREY wires in the electrical box connector (see wiring diagram). To check harness, disconnect it from electrical box. Check continuity between ends of wires (see wiring diagram).

Monitoring Beeper

If beeper does not emit diagnostic codes anymore, while the MPEM gauge supply outlet works, check if beeper functions well, as follows :

1. Access 33-second temporization mode.
2. Disconnect engine overheating sensor wire (any wire on **Speedster**).
3. Ground the disconnected wire.
4. Beeper should be functional. Otherwise, check wiring harness. Also check the beeper by supplying an external 12 Vdc directly to its harness. Polarity is mandatory. Connect the positive supply wire to the PURPLE / TAN wire.

Overheat Sensor

In order to check the engine's overheat sensor wires, proceed as for beeper.

Accessories

If an accessory does not work, first check accessory fuse (on MPEM). It is also possible to check the operation of an accessory by connecting it directly to an external 12 Vdc source. Unplug the 2-wire connector from the fuse block (in front storage compartment). Check the voltage with the meter + probe connected to the RED wire and the - probe to the BLACK wire. The voltage should be of 12 Vdc. If there is no voltage, check the separate 20 A fuse in the electrical box (engine compartment).


If everything above is good, disconnect the large connector from the fuse block. Using a voltmeter, take a reading of the fuse block outlet corresponding with the faulty accessory (see chart below).

ACCESSORY	COLOR	VOLTMETER TEST PROBE +	VOLTMETER TEST PROBE -
Pump	BROWN / ORANGE	Connector's pin no. 21	Ground
Nav / Anc	GREY / ORANGE	Connector's pin no. 18	Ground
Auxiliary supply (for additionnal accessory)	ORANGE	Connector's pin no. 16	Ground
Blower	YELLOW / ORANGE	Connector's pin no. 17	Ground

If there is voltage at the fuse block outlet, problem originates from harness. Check connector wire position, as well as wires continuity in the harness. Refer to wiring diagram.

Switches can be checked using an ohmmeter. When switch is activated, resistance should be below 1 W. When switch is deactivated, resistance should be infinite. The following chart shows switch connections for each accessory.

ACCESSORY SWITCH	TYPE	COUNTER CLOCKWISE	CENTER	CLOCKWISE
Blower	On / Off	NONE	OFF	ON B1-L1 closed
Bilge Pump	On / Off	NONE	OFF	ON B1-L1 closed
Nav / Anc	L2 : On / Off L1 & L2 : On	ON B1-L2 closed	OFF	ON B1-L1-L2 closed

 NOTE : B1, B2, L1, and L2 represent the identification of the switch tabs.

Charging System

MPEM's RED / GREEN wire (additional RED wire for port (LH) side of **Speedster**) with a female bullet is linked to regulator / rectifier. It allows to charge the battery when the engine runs. If the charging system does not work, check charging system fuse then RED /GREEN wire connection. For testing procedures, refer to CHARGING SYSTEM 08-07.

CHARGING SYSTEM

TESTING PROCEDURE 717 ENGINE

○ **NOTE** : First, ensure that battery is in good condition prior to performing the following test using current inductive ammeter such as Snap-on MT 110.

Current Test

Proceed as follows :

- Start engine.
- Install tester over battery positive cable.
- Bring engine to approximately 5500 RPM.

Depending on battery charge, current reading should be approximately 5 amperes. If not, check magneto output prior to concluding that rectifier is faulty.

Voltage Test

- Proceed as follows :
- Start engine.
- Connect a voltmeter (set on DC volt scale) on battery posts.

Bring engine to approximately 5500 RPM.

If voltmeter reads over 15 volts, regulator is defective. Replace it.

○ **NOTE** : Whatever the voltmeter type used (peak voltage or RMS), the voltage must not exceed 15 V. A faulty regulator will allow voltage to exceed 15 V as engine speed is increased.

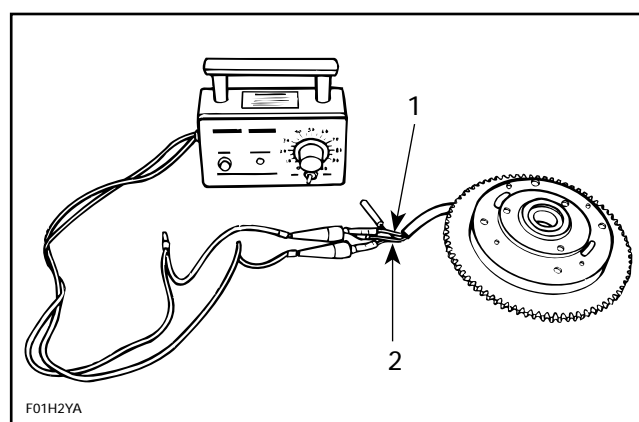
Magneto, Charging System Generator Coil

OUTPUT TEST WITH BOMBARDIER IGNITION TESTER

Operate it as for ignition system verifications.

1. Unplug magneto connector at engine. Connect the 4-pin magneto test harness (P / N 295 000 131) between the unplugged connectors.
2. Connect tester wires then set switch and dial as follows :

Tester wires	Component wires	Tester switch position	Tester dial position
N	YELLOW of magneto harness	LOW	70
P	YELLOW/ BLACK of magneto harness		



TYPICAL

1. YL
2. YL / BK

3. Start engine and observe indicator.

4. Push reset button and repeat step 3 twice.

Results :

- a. **Indicator lamp lights** : Charging system generator coil output is up to specifications.
- b. **Indicator lamp does not light** : Charging system generator coil is faulty. Replace it.

Resistance Measurement

As an alternate method, charging system generator coil can be checked with an ohmmeter (preferably a digital one).

Unplug magneto connector at engine. Connect the 4-pin magneto test harness (P / N 295 000 131) at the engine. DO NOT connect the other end at the boat's harness.

Section 08 ELECTRICAL
Sub-Section 07 (CHARGING SYSTEM)

Use the following table :

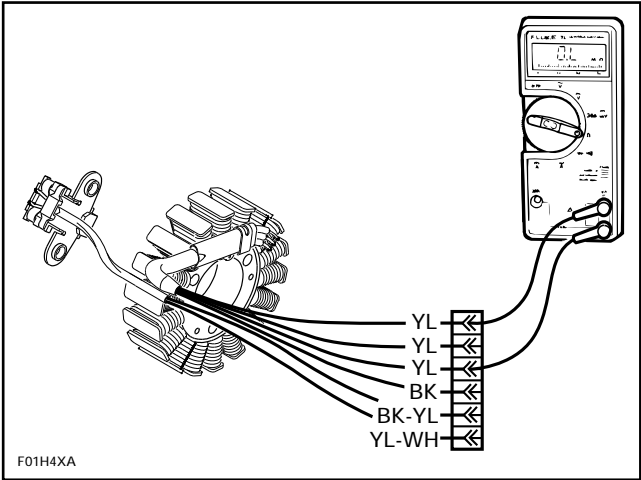
MAGNETO		
PART NAME	WIRE COLOR	RESISTANCE (OHM) (Ω)
Charging system generator coil	YELLOW with YELLOW / BLACK of magneto harness	0.05 - 0.6

TESTING PROCEDURES
787 ENGINE

Stator

STATIC TEST : CONTINUITY

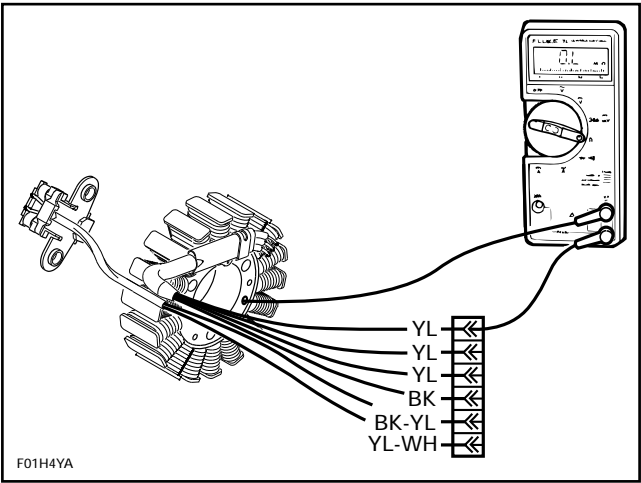
1. Disconnect the magneto wiring harness connector. Connect the 6-pin magneto test harness (P / N 295 000 136) on the engine connector only. With a good multi-meter (preferably a digital), place the 2 meter leads onto the stator wire leads AC-1 and AC-2 of the stator. The resistance should be within 0.1-1.0 ohm.



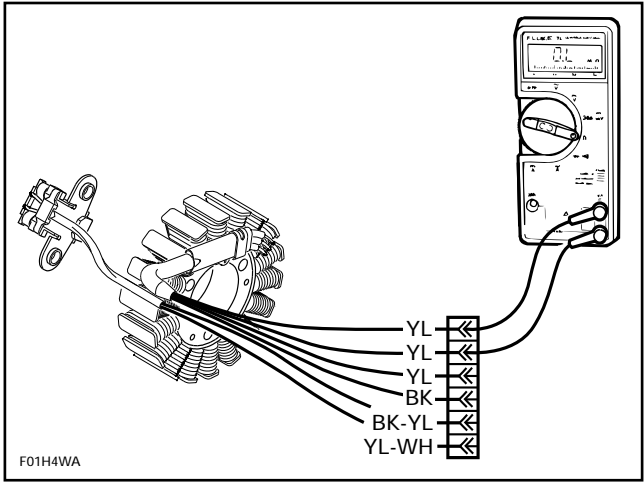
TYPICAL

STATIC TEST : INSULATION

With the stator leads disconnected, insert either meter lead onto AC-1 and ground the other meter lead to the engine or the stator iron core and note the reading. There should be no continuity (infinity) between the stator insulated coils and ground. If there is a reading, the stator coils and / or the wiring from the coils is grounded and needs to be replaced / repaired respectively.



TYPICAL



TYPICAL

2. Place either meter lead into the remaining stator lead (AC-3) and note the resistance (same as step no. 1). If the readings are out of specification, the stator will need to be replaced.

Rectifier / Regulator

STATIC TEST : CONTINUITY

1. Due to internal circuitry, there is no static test available.

DYNAMIC TEST

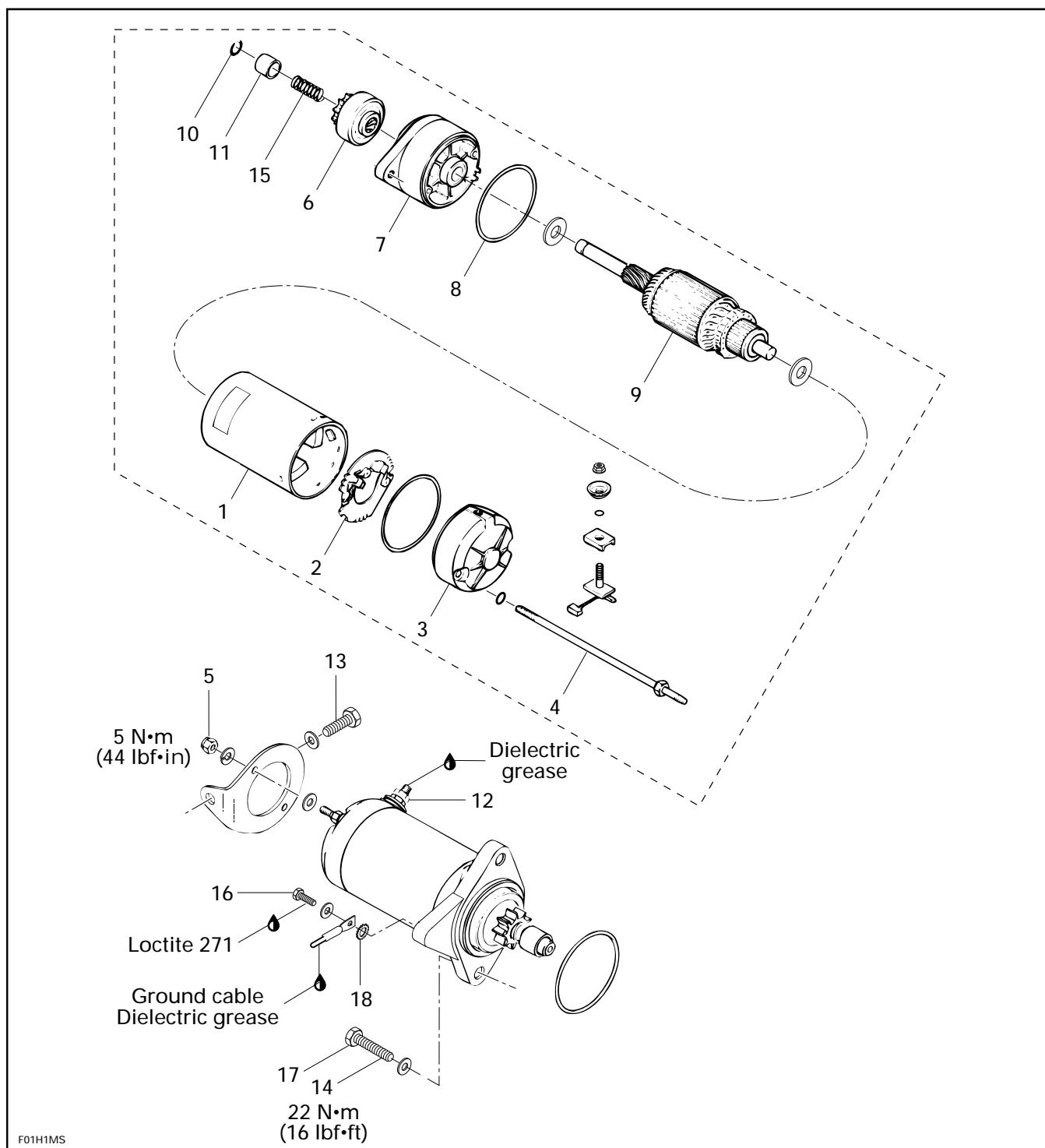
1. Disconnect the RED lead coming out of the rectifier / regulator.
2. Connect the multimeter + lead to the rectifier / regulator RED wire and the - lead to ground.
3. With the engine running at 5500 RPM, DC output should be above 13.5 volts, but below 14.8 volts. If voltage is above or below these readings, the rectifier / regulator is defective and needs to be replaced.

All Engines

○ **NOTE :** If it is continually necessary to add distilled water to the battery, this indicates an over voltage situation, requiring replacement of the rectifier / regulator. If, on the other hand, the battery will not stay charged, the problem can be any of the charging circuit components. If these all check good, you would be accurate in assuming the problem to be in the rectifier / regulator.

STARTING SYSTEM

ELECTRIC STARTER



Section 08 ELECTRICAL

Sub-Section 08 (STARTING SYSTEM)

GENERAL

Causes of troubles are not necessarily related to starter but may be due to a burnt fuse, faulty battery, ignition switch, start / stop switch, safety lanyard switch, solenoid, electrical cables or connections.

Check these components before removing starter. Consult also the Starting System Troubleshooting, table on next page for a general view of possible problems.

◆ **WARNING :** Short circuiting electric starter is always a danger, therefore disconnect the battery ground cable before carrying out any kind of maintenance on starting system. Do not place tools on battery.

MPEM Supply Fuse

Make sure the MPEM supply fuse in good condition.

Battery

To check battery condition, refer to ELECTRICAL SYSTEM 08-07.

Ignition Switch, Engine Start / Stop Switch and Safety Lanyard Switch

Refer to MPEM 08-05 for procedures.

Solenoid

○ **NOTE :** Solenoid is located in electrical box.

Disconnect large cables from solenoid.

Inspect connections and clean as necessary. Solenoid condition can be checked with an ohmmeter. Install test probes on large connectors of solenoid. Measure resistance when current is applied to small connectors ; if it is more than a few ohms, replace solenoid.

Electrical Cables or Connections

Check all connections, cables and wires. Tighten any loose cables. Replace any chafe wires.

STARTING SYSTEM TROUBLESHOOTING

SYMPTOM	CAUSE	REMEDY
Starter does not turn.	Burnt MPEM supply fuse.	Check wiring condition and replace fuse.
	Poor contact of battery terminal(s) or ground cable connections.	Clean and tighten terminal(s).
	Weak battery.	Recharge battery.
	Poor contact or open circuit of : ignition switch, start / stop switch, safety lanyard switch or solenoid.	Check and replace defective part. Refer to MPEM 08-05.
Starter turns ; but does not crank the engine.	Poor contact of battery terminal(s).	Clean and tighten terminal(s).
	Poor battery ground cable connection.	Clean and tighten.
	Burnt or poor contact of solenoid switch contact disc.	Replace solenoid switch.
	Poor contact of brush.	Straighten commutator and brush.
	Burnt commutator.	Turn commutator in lathe.
	Worn commutator segments.	Undercut mica.
	Shorted armature.	Repair or replace armature.
	Weak brush spring tension.	Replace brush holder
	Weak magnet.	Replace bushings.
	Worn bushings.	Replace bushings.
	Weak battery.	Recharge or replace battery.
Starter turns, but overrunning clutch pinion does not mesh with ring gear.	Worn clutch pinion gear.	Replace clutch.
	Defective clutch.	Replace clutch.
	Poor movement of clutch on splines.	Clean and correct.
	Worn clutch bushing.	Replace clutch.
	Worn ring gear.	Recharge ring gear.
Starter motor keeps running	Shorted solenoid switch winding.	Replace solenoid switch.
	Melted solenoid contacts.	Replace solenoid switch.
	Sticking or defective starter clutch.	Lubricate or replace.
	Presence of salt water in the electrical box which gives continuity.	Verify electrical box watertightness

REMOVAL

Disconnect BLACK cable ground connection from battery.

◆ **WARNING :** Always disconnect ground cable first and reconnect last.

Disconnect RED cable connection from battery.

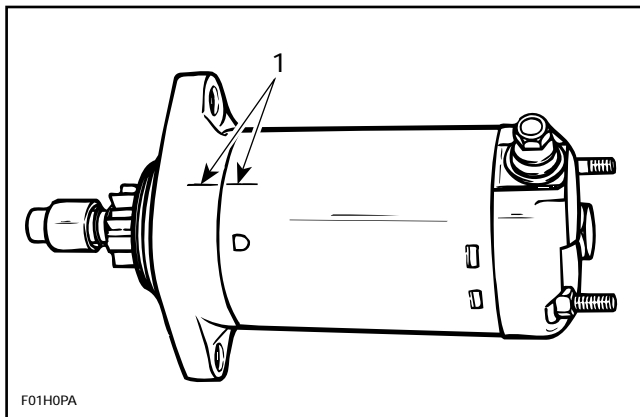
Remove the following parts.

- cables from starter
- screw of starter rear support (no. 23)
- starter mount screws (no. 19)

DISASSEMBLY

1,2,3,4,5, Yoke, Brush Holder, End Frame, Through Bolt and Nut

Before disassembling, trace index marks on yoke and clutch housing to ease further assembly.



TYPICAL

1. Trace indexing marks here

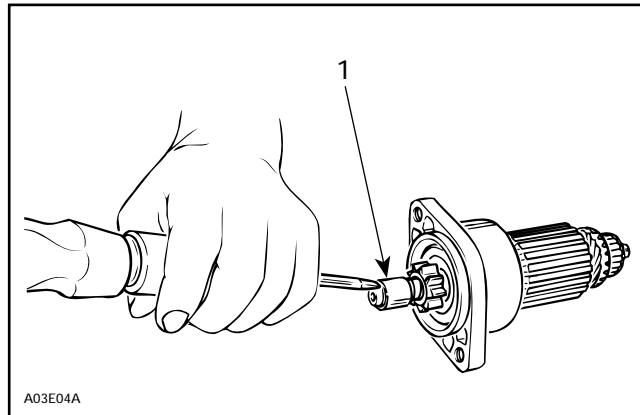
Remove starter support nuts then through bolts. Separate end frame from yoke assembly. Withdraw yoke assembly from armature.

Brush holder can be removed from end frame by unscrewing nut retaining terminal.

Check that the radial play between the armature shaft and end frame is not greater than 0.20 mm (.008 in). Replace end frame if so.

10,11,15 Circlip, Pinion Stop Collar and Spring

Tap the pinion stop collar using a screwdriver. Remove circlip. Disassemble pinion stop collar and spring.



1. Pinion stop collar

6,7,8,9, Clutch Ass'y, Housing, O-ring and Armature

Turn assembly clockwise to remove it from armature assembly.

Pull housing from armature.

CLEANING

▼ **CAUTION :** Yoke ass'y and drive unit assembly must not be immersed in cleaning solvent.

Discard all O-rings and gasket.

Clean brushes and holders with a clean cloth soaked in solvent. Brushes must be dried thoroughly with a clean cloth.

Blow brush holders clean using compressed air.

◆ **WARNING :** Always wear safety glasses when using compressed air.

Remove dirt, oil or grease from commutator using a clean cloth soaked in suitable solvent. Dry well using a clean, dry cloth.

Clean engine ring gear teeth and drive unit (clutch).

○ **NOTE :** Bushings must not be cleaned with grease dissolving agents.

Immerse all metal components in cleaning solution. Dry using a clean, dry cloth.

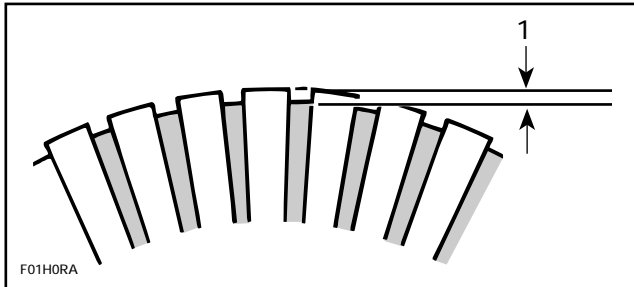
INSPECTION

Armature

○ **NOTE :** An ohmmeter may be used for the following testing procedures, except for the one concerning shorted windings in armature.

Check commutator for roughness, burnt or scored surface. If necessary, turn commutator on a lathe, enough to resurface only.

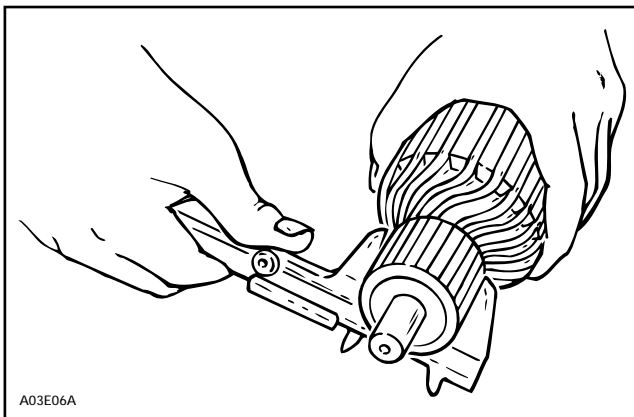
Check commutator for mica depth. If depth is less than 0.20 mm (.008 in), undercut mica. Be sure that no burrs are left and no copper dust remains between segments after undercutting operation is completed.



1. Commutator undercut 0.20 mm (.008 in)

Check commutator out of round condition with V-shaped blocks and an indicator. If commutator out of round is more than 0.40 mm (.016 in), commutator should be turned on a lathe.

Check commutator outer diameter. If less than 27 mm (1.063 in), replace.



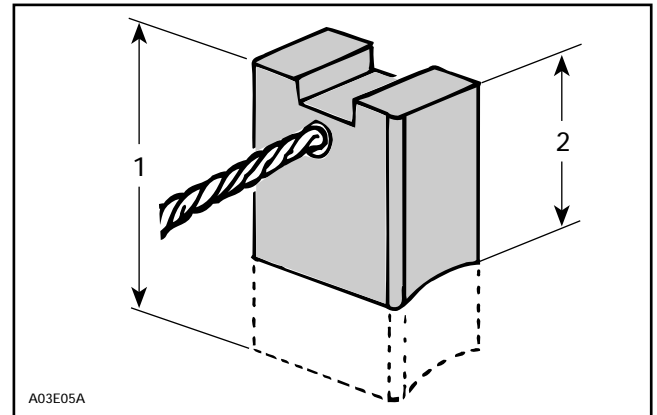
Brush Holder

Check brush holder for insulation using an ohmmeter. Place one test probe on insulated brush holder and the other test probe on brush holder plate. If continuity is found, brush holder has to be repaired or replaced.

Brush Length

Measure brush length. If less than 8.5 mm (.335 in), replace them.

○ **NOTE :** New brush length is 12 mm (.472 in).



1. New
2. Wear limit, 8.5 mm (.335 in)

Overrunning Clutch

Pinion of overrunning clutch should turn smoothly in clockwise direction, and should not slip in a counterclockwise direction. If defective, replace.

Check pinion teeth for wear and damage. If defective, replace.

○ **NOTE :** Always check engine ring gear teeth for wear and damage. If defective replace ring gear. Refer to ENGINE 03-04 then refer to Ring Gear.

ASSEMBLY

Reverse the order of disassembly to reassemble starter. However, attention should be paid to the following operations.

Prior to assembling, coat sliding surfaces on armature shaft splines, overrunning clutch and bushing with G.E. Versilube G 341 M or ESSO Beacon 325 lubricant or equivalent.

Apply motor oil on metal bushings.

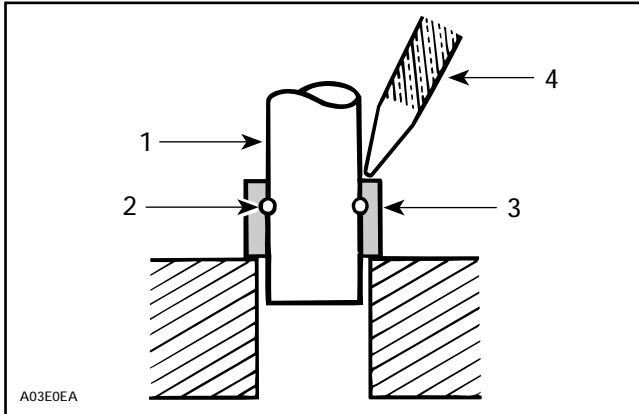
10,11, Circlip and Pinion Stop Collar

After placing stop collar on armature shaft, fit circlip into armature shaft, then make sure that it is properly secured.

Slide stop collar over circlip and secure in place by punching it at 2 or 3 places.

Section 08 ELECTRICAL

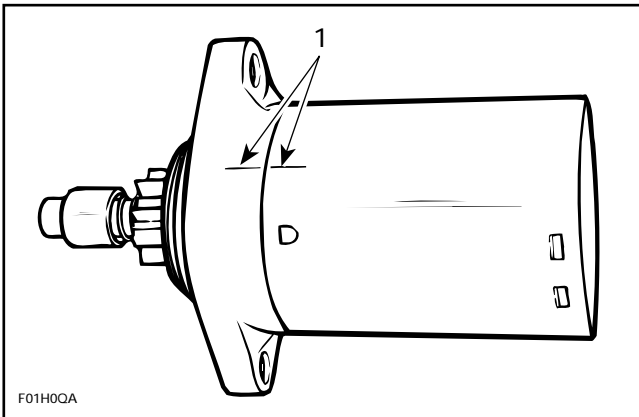
Sub-Section 08 (STARTING SYSTEM)



1. Armature shaft
2. Circlip
3. Pinion stop collar
4. Punch

1,7, Yoke Ass'y and Housing

Align previously traced indexing marks.



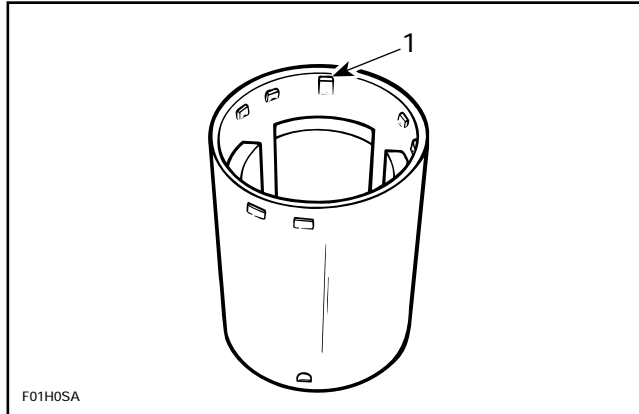
TYPICAL

1. Align marks

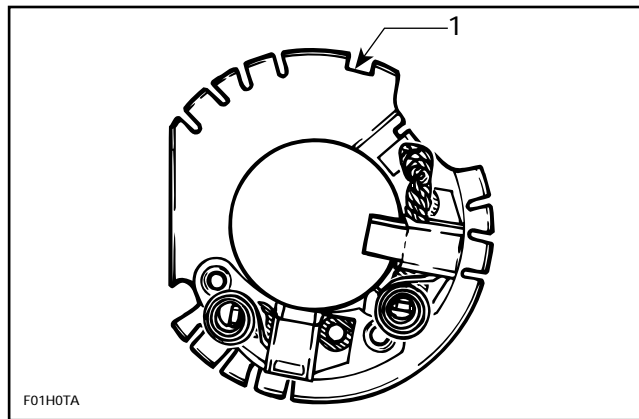
1,3,4, Yoke Ass'y, End Frame and Through Bolt

Open brushes and slide over commutator.

Align end frame locating notch with yoke locating protrusion and properly sit brush holder into yoke.

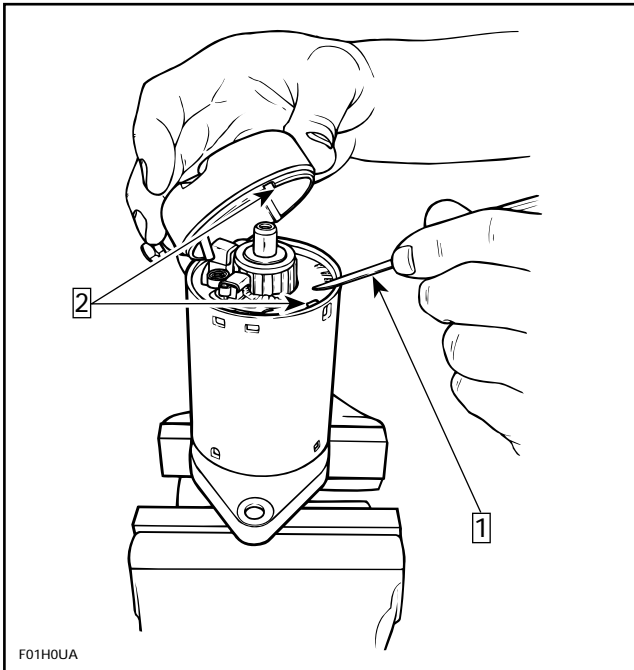


1. Locating protrusion is the higher one



1. Brush holder locating notch

To ease end frame installation, retain brush holder with a small screwdriver while installing end frame.



1. Step : Retaining brush holder with a screwdriver
2. Step : Align here

Align end frame notch with brush holder notch / yoke protrusion.

▼ **CAUTION** : Make sure end frame fits perfectly on yoke.

STARTER INSTALLATION

Installation is essentially the reverse of removal procedure. However, pay particular attention to the following.

Make sure that starter and engine mating surfaces are free of debris. Serious trouble may arise if starter is not properly aligned.

13,17, Screw

Torque starter screws to 22 N•m (16 lbf•ft).

12, Nut

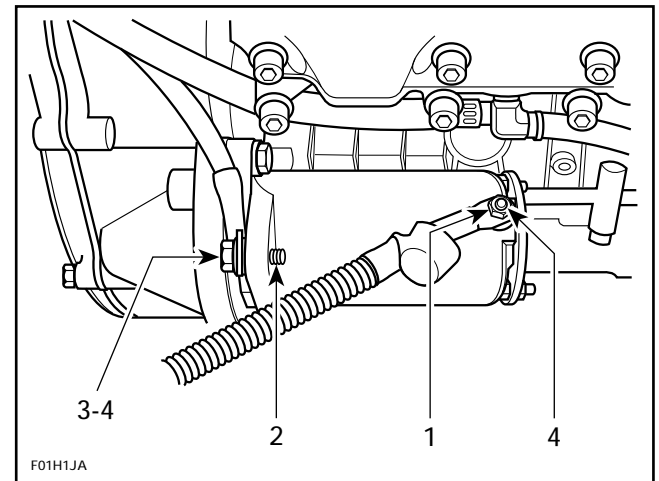
Connect the RED battery cable to the starter and torque nut to 6 N•m (53 lbf•in). Apply dielectric grease on terminal and nut.

16,18, Screw and Teeth Washer

Apply Loctite 271 (red) on screw.

Connect BLACK cable to starter using flat washer, teeth washer and screw. Torque screws to 22 N•m (16 lbf•ft). Apply dielectric grease on terminal and screw.


◆ **WARNING** : Always connect RED positive cable first then BLACK negative cable last. Whenever connecting the RED positive cable to the starter motor make sure the battery cables are disconnected to prevent electric shock.



TYPICAL - 717 ENGINE SHOWN

1. Torque to 6 N•m (53 lbf•in)
2. Loctite 271
3. Torque to 22 N•m (16 lbf•ft)
4. Dielectric grease

STARTER SPECIFICATION

Nominal output		0.6 kW
Voltage		12 V
Rated time		30 seconds
Rotation		Counterclockwise (viewed from pinion side)
Weight		Approx. 2 kg (4.4 lb)
Performance specification at 20°C(68°F)	No load	11.5 V 20 A max. 5500 RPM
	Load	717 engine : 8.5 V 170 A max. 2200 RPM 2.2 N•m (20 lbf•in) 787 engine : 8.5 V 170 A max. 2200 RPM 2.2 N•m (20 lbf•in)
	Stall	717 engine : 5 V 350 A max. 0 RPM 3 N•m (27 lbf•in) 787 engine : 5 V 350 A max. 0 RPM 3.2 N•m (29 lbf•in)
Battery		Sportster and Challenger : Every RV24-130, 25 A•h (130 minutes reserve minimum) or RV24-160 (160 minutes) or equivalent.  WARNING : Never use automotive type battery. Its mechanical construction does not allow to meet the shock conditions where boats operate. Only use the type of battery recommended.
		Speedster : 2 x 19 A

BATTERY

TROUBLESHOOTING

SYMPTOM : DISCHARGED OR WEAK BATTERY	
CAUSE	REMEDY
1. Battery posts and / or cable terminal oxidized.	Clean and coat with dielectric grease.
2. Loose or bad connections.	Check wiring and connector cleanliness, damaged or short circuit.
3. Faulty battery (sulfated, doesn't keep a full charge, damaged casing, loose rectifier.	Replace.
4. Charging system fuse burnt or faulty rectifier.*	First check charging system generator coil. If it is in good condition replace fuse or rectifier.
5. Faulty charging system generator coil.**	Replace.

*To test charging system, refer to CHARGING SYSTEMS 08-06 then look for Current Test.

**To test charging system generator coil, refer to CHARGING SYSTEMS 08-06 then look for Charging System Generator Coil.

REMOVAL

○ **NOTE** : All the following information about battery vent pertains to Speedster only.

◆ **WARNING** : Battery **BLACK** negative cable must always be disconnected first and connected last. Never charge or boost battery while installed on boat. Electrolyte or fuel vapors can be present in engine compartment and a spark might ignite them and possibly cause personal injuries.

Proceed as follows :

1. Disconnect the **BLACK** negative cable first.
2. Then disconnect the **RED** cable last.
3. Remove the vent line from the battery.
4. Remove the holding straps.
5. Withdraw battery from boat being careful not lean it so that electrolyte flows out of vent elbow.

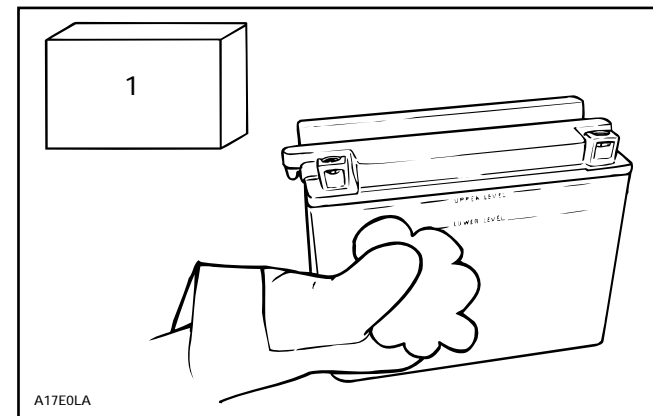
▼ **CAUTION** : Should any electrolyte spillage occur, immediately wash off with a solution of baking soda and water to prevent damage to boat components.

◆ **WARNING** : Electrolyte is poisonous, dangerous and explosive. It contains sulfuric acid and can cause severe burns. Avoid contact with eyes, skin and clothing.

CLEANING

Clean the battery casing, caps, cables and battery posts using a solution of baking soda and water.

▼ **CAUTION** : Do not allow cleaning solution to enter battery interior since it will destroy the electrolyte chemical properties.



TYPICAL

1. Baking soda

Remove corrosion from battery cable terminals and battery posts using a firm wire brush. Rinse with clear water and dry well.

INSPECTION

Visually inspect battery casing for cracks or other possible damage. If casing is damaged, replace battery and thoroughly clean battery tray and close area with water and baking soda.

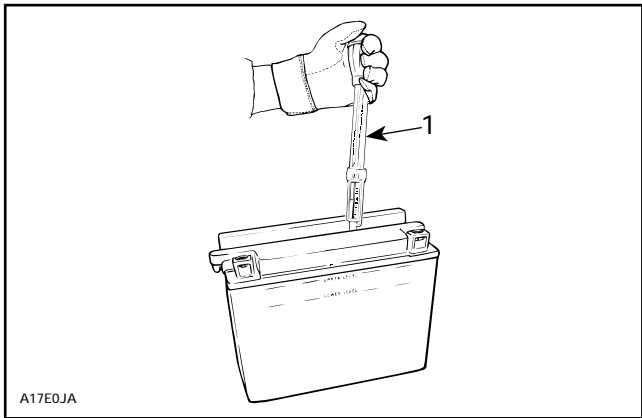
◆ **WARNING** : Should the battery casing be damaged, wear a suitable pair of non-absorbent gloves when removing the battery by hand.

Inspect battery posts for security of mounting.

Inspect for cracked or damaged battery caps, replace defective caps.

◆ **WARNING** : Battery caps do not have vent holes. Make sure that vent line is not obstructed.

HYDROMETER TEST



1. Specific gravity 1.260

A hydrometer measures the charge of a battery in terms of specific gravity of the electrolyte. Most hydrometers give a true reading at 21°C (70°F).

In order to obtain correct readings, adjust the initial reading by adding .004 points to the hydrometer readings for each 5.5°C (10°F) above 21°C (70°F) and by subtracting .004 point for every 5.5°C (10°F) below 21°C (70°F).

This chart will be useful to find the correct reading.

ELECTROLYTE TEMPERATURE		OPERATION TO PERFORM	
°C	°F		
38	100	add	.012
32	90		.008
27	80		.004
21	70	correct reading	
16	60	subtract	.004
10	50		.008
4	40		.012
-1	30		.016
		from the reading	

EXAMPLE NO. 1

Temperature below 21°C (70°F) :

Hydrometer reading : 1.250

Electrolyte temperature : -1°C (30°F)

Subtract .016 Sp. Gr.

Corrected Sp. Gr. is 1.234

EXAMPLE NO. 2

Temperature above 21°C (70°F) :

Hydrometer reading : 1.235

Electrolyte temperature : 38°C (100°F)

Add .012 Sp. Gr.

Corrected Sp. Gr. is 1.247

BATTERY STORAGE

Disconnect and remove battery from boat.

Check electrolyte level in each cell, add distilled water up to upper level line.

▼ CAUTION : Do not overfill.

The battery must always be stored in fully charged condition. If required, charge until specific gravity of 1.260 is obtained.

▼ CAUTION : Battery electrolyte temperature must not exceed 50°C (122°F). The casing should not feel hot.

Clean battery terminals and cable connections using a wire brush. Apply a light coat of dielectric grease on terminals.

Clean battery casing and caps using a solution of baking soda and water.

▼ CAUTION : Do not allow cleaning solution to enter battery, otherwise it will destroy the electrolyte.

Rinse battery with clear water and dry well using a clean cloth.

Store battery on a wooden shelf in a cool dry place. Such conditions reduce self-discharging and keep fluid evaporation to a minimum. Keep battery away from dew, high moisture and direct sunlight.

During the storage period, recheck electrolyte level and specific gravity readings at least every month. If necessary, keep the battery at its upper level line and near full charge as possible (trickle charge).

ACTIVATION OF NEW BATTERY

◆ WARNING : Never charge or boost battery while installed in boat.

○ NOTE : The following is specific for the Speedster.

For Sportster and Challenger, follow battery manufacturer instructions.

A new battery is factory fresh dry charged. For storage purposes, it is fitted with a temporary sealing tube.

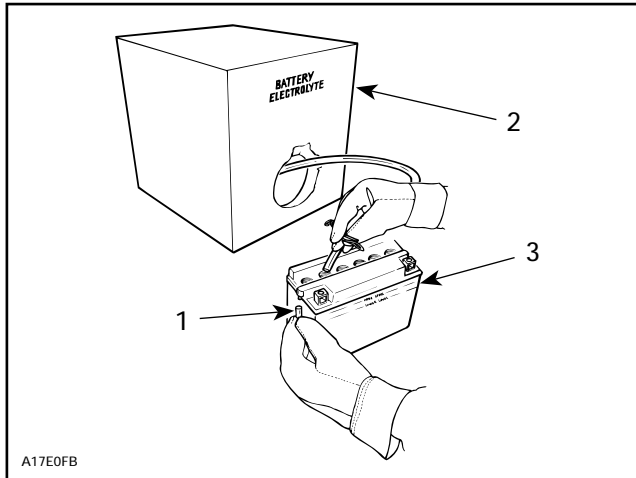
▼ CAUTION : Do not remove the sealing tube or loosen battery caps unless activation is desired.

In case of accidental premature removal of caps or sealing tube, battery should be given a full charge.

Perform the following operations any time a new battery is to be installed.

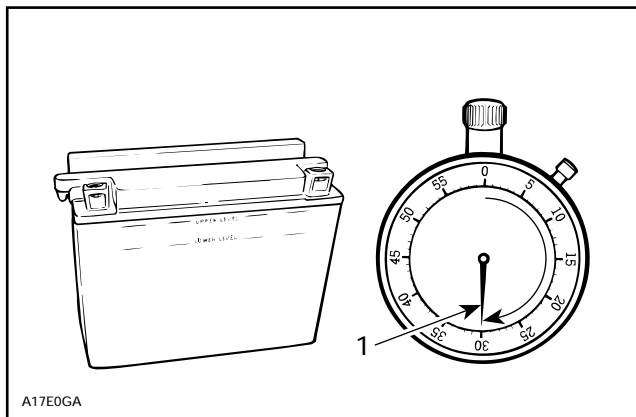
1. Remove the sealing tube from the vent elbow.

◆ **WARNING :** Failure to remove the sealing tube could result in an explosion.



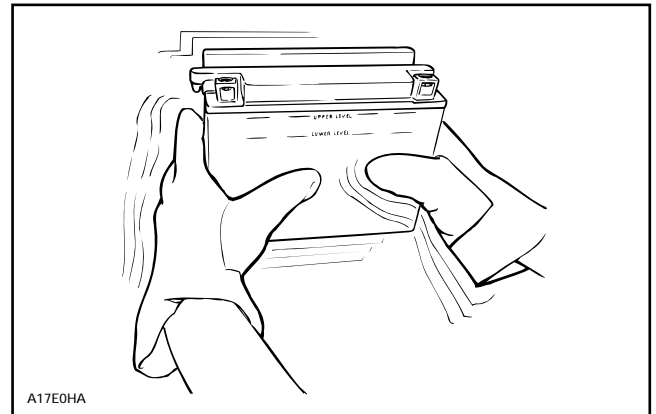
1. Sealing tube
2. Battery electrolyte
3. Upper level line

2. Remove caps and fill battery to UPPER LEVEL line with electrolyte (specific gravity : 1.260 at 21°C (70°F)).
3. Allow the battery to stand for 30 minutes MINIMUM so that electrolyte soak through battery cells.

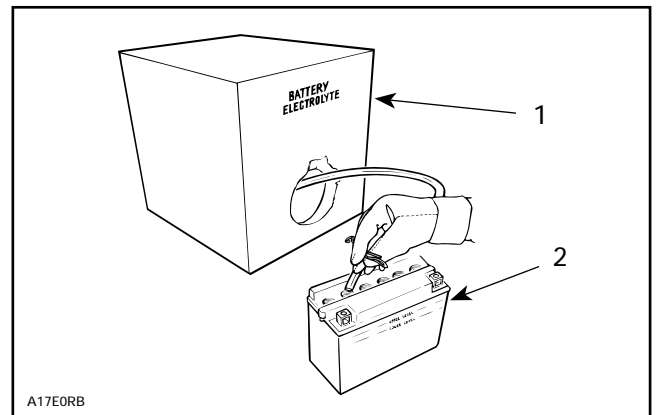


1. 30 min

4. Allow gas bubbles to escape by lightly shaking battery by hand.

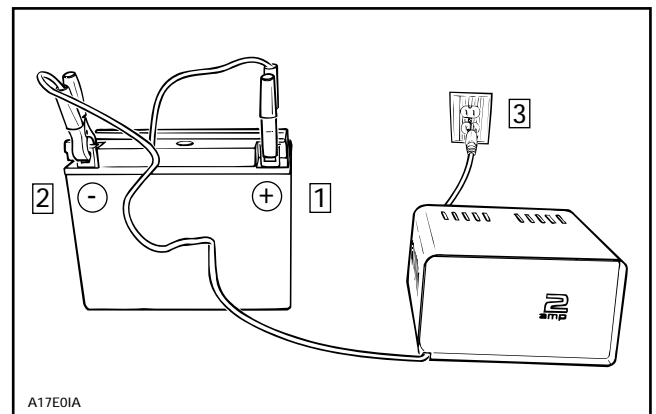


5. Readjust the electrolyte level to the UPPER LEVEL line.



1. Battery electrolyte
2. Upper level line

6. Connect a 2 A battery charger for 3 to 5 hours.



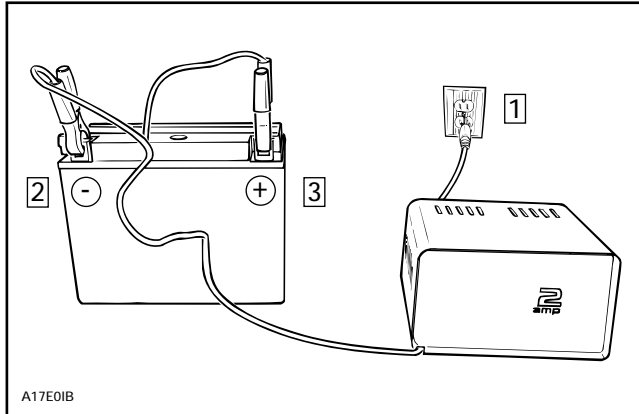
▼ **CAUTION :** If charging rate raises higher than 2.4 A reduce it immediately. If cell temperature rises higher than 50°C (122°F) or if the casing feels hot, discontinue charging temporarily or reduce the charging rate.

Section 08 ELECTRICAL

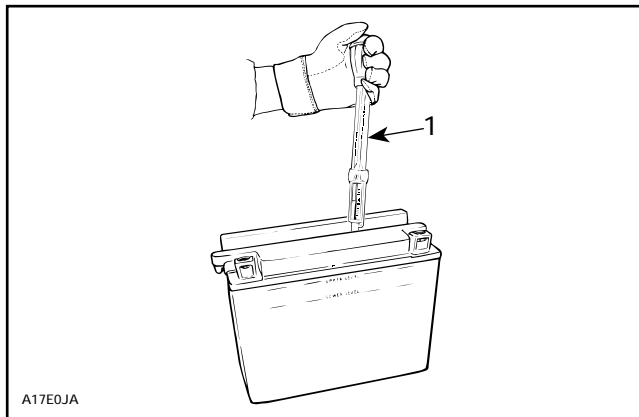
Sub-Section 08 (STARTING SYSTEM)

◆ **WARNING :** Gases given off by a battery being charged are highly explosive. Always charge in a well ventilated area. Keep battery away from cigarettes or open flames. Always turn battery charger off prior to disconnecting cables. Otherwise a spark will occur and battery might explode.

7. Disconnect battery charger.

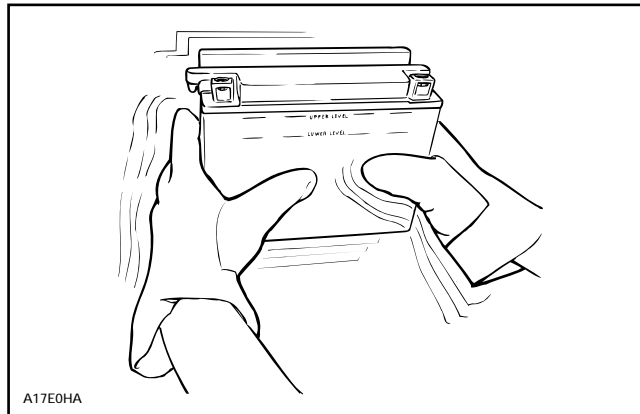


8. Test battery state of charge. Use a hydrometer.



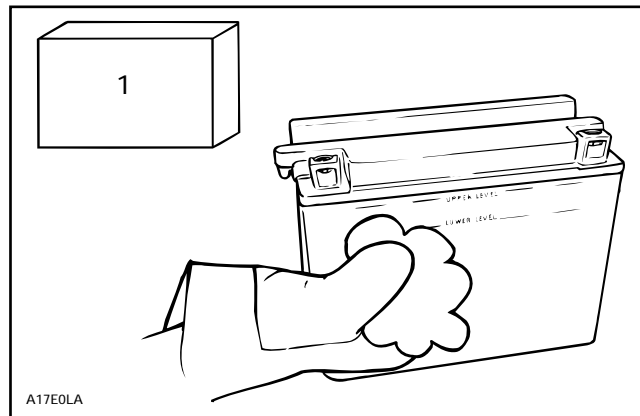
1. Specific gravity 1.260

9. Allow gas bubbles to escape by slightly shaking battery.



10. If electrolyte level has dropped after charging, fill with distilled water to UPPER LEVEL line. After water is added, continue charging for 1 to 2 hours to mix water with electrolyte.

11. Reinstall caps and clean any electrolyte spillage using a solution of baking soda and water.



1. Baking soda

12. Reinstall battery. Hook up battery cables observing correct polarity and coat terminals with dielectric grease.

Install vent line.

○ **NOTE :** A check valve is installed on vent line to prevent water infiltration into battery.

▼ **CAUTION :** Negative battery terminal should always be disconnected FIRST and reconnected LAST.

◆ **WARNING :** Vent line must be free and open. A kinked or bent line will restrict ventilation and create gas accumulation that might result in an explosion.

○ **NOTE :** It is recommended to verify the battery charge once a month. If necessary, fully charge battery.

SERVICING

Electrolyte Level

Since a battery has been activated (see above), add distilled water to top up electrolyte.

TIPS FOR CHARGING A USED BATTERY

◆ **WARNING :** Prior to charging the battery, always remove it from jet boat to prevent electrolyte spillage and to prevent the possibility of a spark in engine compartment.

For best results, battery should be charged when the electrolyte and the plates are at room temperature. A battery that is cold may not accept current for several hours after charging begun.

Do not charge a frozen battery. If the battery charge is very low, the battery may freeze. If it is suspected to be frozen, keep it in a heated area for about 2 hours before charging.

◆ **WARNING :** Do not place battery near open flame.

The time required to charge a battery will vary depending on some factors such as :

- Battery temperature : The charging time is increased as the temperature goes down. The current accepted by a cold battery will remain low. As the battery warms up, it will accept a higher rate of charge.
- State of charge : Because the electrolyte is nearly pure water in a completely discharged battery, it cannot accept current as well as electrolyte. This is the reason the battery will not accept current when the charging cycle first begins. As the battery remains on the charger, the current from the charger causes the electrolytic acid content to rise which makes the electrolyte a better conductor and then, the battery will accept a higher charging rate.
- Type of charger : Battery chargers vary in the amount of voltage and current that they can supply. Therefore, the time required for the battery to begin accepting measurable current will also vary.

Charging a Very Flat or Completely Discharged Battery

Unless this procedure is properly followed, a good battery may be needlessly replaced.

- Measure the voltage at the battery posts with an accurate voltmeter. If it is below 10 volts, the battery will accept current at very low rate, in term of milliamperes, because electrolyte is nearly pure water as explained above. It could be some time before the charging rate increases. Such low current flow may not be detectable on some charger ammeters and the battery will seem not to accept any charge.

- Exceptionally for this particular case, set the charger to a high rate.

○ **NOTE :** Some chargers have a polarity protection feature which prevents charging unless the charger leads are connected to the correct battery terminals. A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly. This will make it appear that the battery will not accept a charge. Follow the charger manufacturer's instruction on how to bypass or override this circuitry so that the charger will turn on and charge a low-voltage battery.

- Since the battery chargers vary in the amount of voltage and current they provide, the time required for the battery to accept measurable charger current might be up to approximately 10 hours or more.
- If the charging current is not up to a measurable amount at the end of about 10 hours, the battery should be replaced.
- If the charging current is measurable before the end or at the end of about 10 hours, the battery is good and charging should be completed in the normal manner as specified in Activation of a new battery.
- It is recommended that any battery recharged by this procedure be load tested prior to returning it to service.

BATTERY CHARGING EQUIPMENT

The battery charger should have an adjustable charging rate. Variable adjustment is preferred, but a unit which can be adjusted in small increments is acceptable.

The battery charger must be equipped with an ammeter capable of accurately measuring current of less than one ampere.

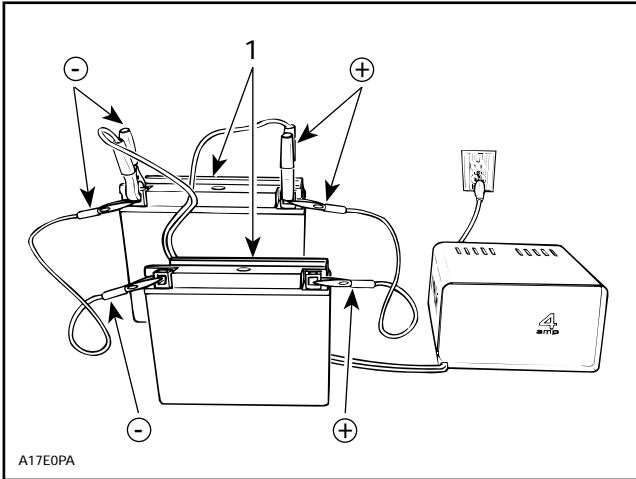
Section 08 ELECTRICAL

Sub-Section 08 (STARTING SYSTEM)

Charging 2 or More Batteries at a Time

Connect all positive battery posts together and use a charger with a capacity (rated) equal to : number of battery to be charged multiply by 2 A.

For example : Charging 5 batteries at a time requires a 10 A rated charger (5 x 2 A = 10 A).



TYPICAL

1. 2 batteries = 4 A

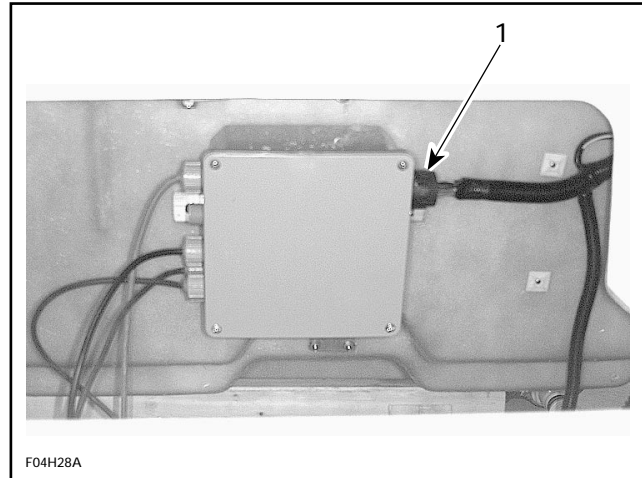
INSTALLATION OF BATTERY

Proceed as follows :

1. Install battery in its emplacement.
2. Secure vent line to the battery. Ensure vent line is not kinked or obstructed. Ensure check valve is not blocked.

◆ **WARNING :** Vent line must be free and open. If not, it will restrict ventilation and create a gas accumulation that could result in an explosion. Gases given off by a battery being charged are highly explosive. Always charge in a well ventilated area. Keep battery away from cigarettes or open flames. Avoid skin contact with electrolyte.

◆ **WARNING :** To prevent any possible spark that may occur at the battery terminals while connecting the cables, unscrew and disconnect the connector at the electrical box PRIOR TO CONNECTING THE BATTERY CABLES.



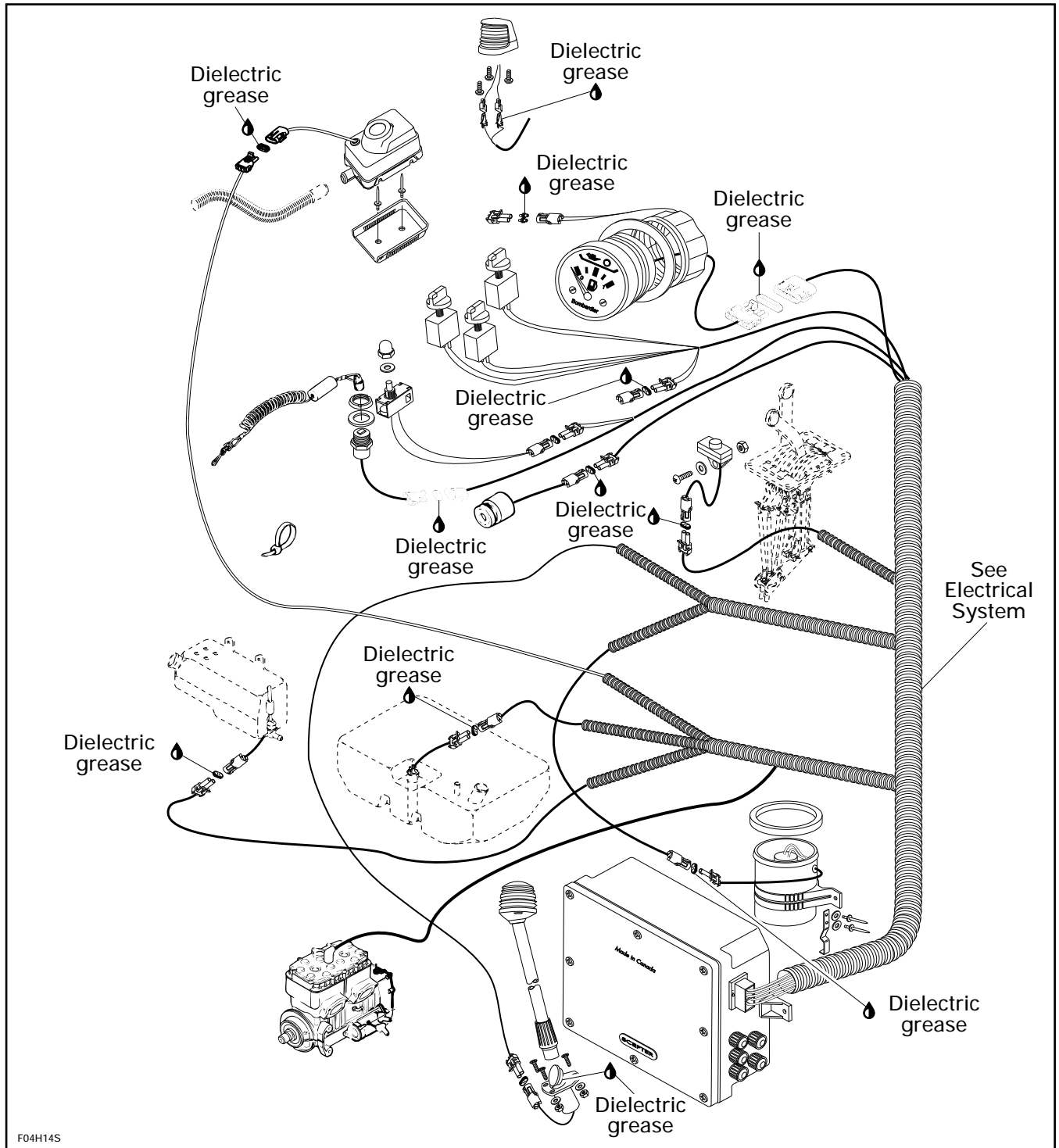
1. Electrical box connector

◆ **WARNING :** Always connect RED positive cable first then BLACK negative cable last.

3. First connect RED positive cable.
4. Then connect BLACK negative cable last.
5. Apply anticorrosion product (salt water resistant) such as dielectric grease on battery posts.
6. Verify cable routing and attachment.
7. Reinstall the electrical box connector.

INSTRUMENTS AND ACCESSORIES

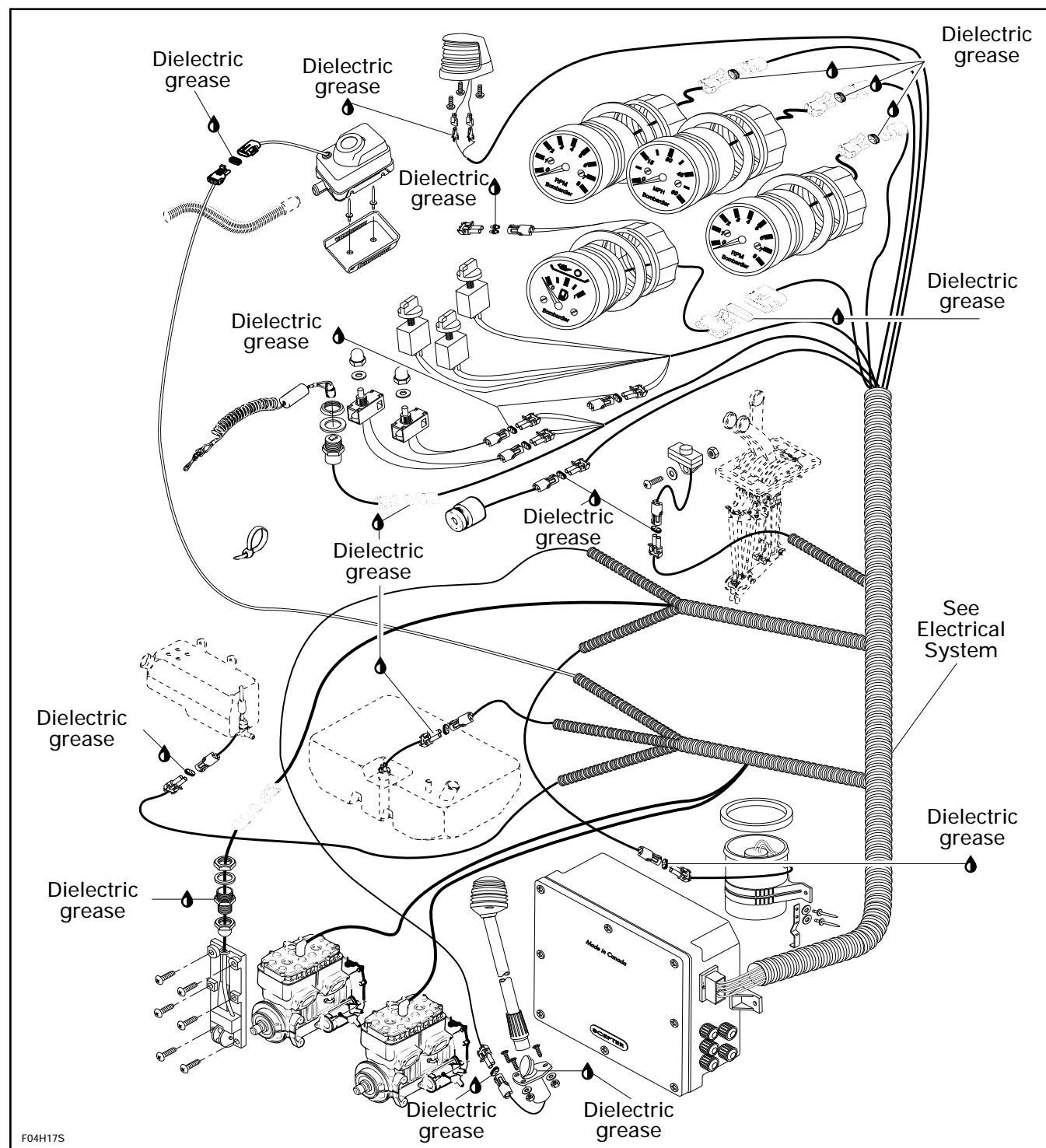
Sportster



F04H14S

Section 08 ELECTRICAL
Sub-Section 09 (INSTRUMENTS AND ACCESSORIES)

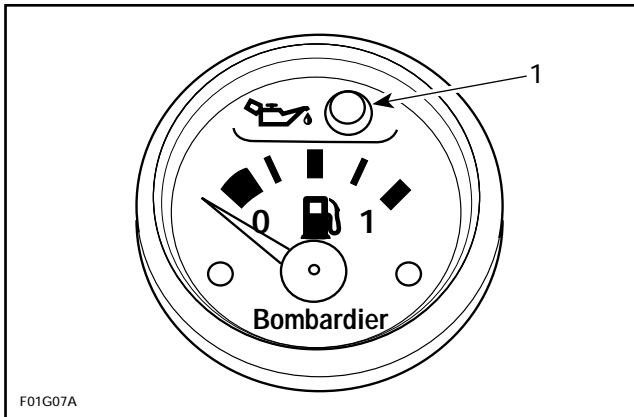
Speedster



FUEL / OIL GAUGE

The fuel / oil gauge has a pointer which indicates fuel level. To verify if fuel pointer works, first touch start /stop button (with safety lanyard removed) to activate electrical system for about 33 seconds.

The oil level pilot lamp is part of the fuel gauge. It will light when injection oil level is low.

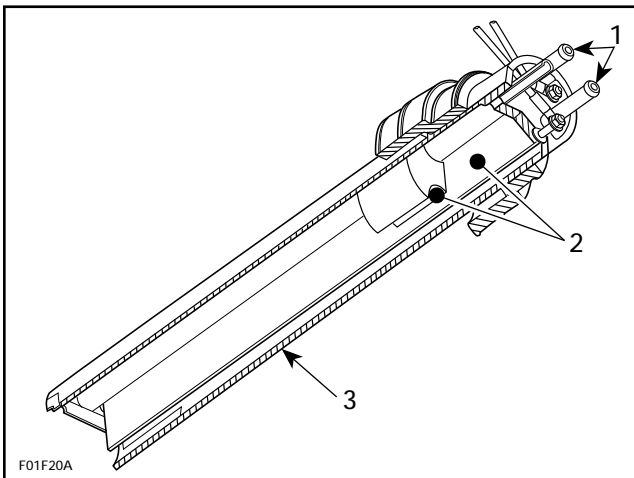


1. Low oil warning light

Fuel Baffle Pick-Up Sensor Verification

The baffle pick-up has an integrated fuel sensor.

To verify fuel sensor, a resistance test should be performed with an ohmmeter allowing the float to move up through a sequence.



1. Pick-up tube
2. Fuel sensor
3. Baffle pick-up

The resistance measured between BLACK / GREEN and GREEN wires must be in accordance with fuel level (measured from under the flange) as specified in the following charts.

Speedster

FUEL LEVEL AND RESISTANCE		
FUEL LEVEL		RESISTANCE
mm	(in)	(Ω)
From 46.6 @ 68.6	(1-27/32 à 2-45/64)	0 \pm 0.1
From 68.6 @ 92.3	(2-45/64 à 3-41/64)	17.8 \pm 0.2
From 92.3 @ 116.0	(3-41/64 à 4-37/64)	27.8 \pm 0.3
From 116.0 @ 139.7	(4-37/64 à 5-1/2)	37.8 \pm 0.4
From 139.7 @ 163.4	(5-1/2 à 6-7/16)	47.8 \pm 0.54
From 163.4 @ 187.1	(6-7/16 à 7-3/8)	57.8 \pm 0.6
From 187.1 @ 210.8	(7-3/8 à 8-19/64)	67.8 \pm 0.7
From 210.8 @ 234.5	(8-19/64 à 9-15/64)	77.8 \pm 0.8
From 234.5 and more	(9-15/64) and more	89.8 \pm 0.9

Challenger

FUEL LEVEL AND RESISTANCE			
FUEL LEVEL			RESISTANCE
	mm	(in)	(Ω)
full	299 and more	11.8 and more	0 ± 2.2
7/8	272 @ 298	10.7 @ 11.7	17.8 ± 2.2
3/4	247 @ 271	9.7 @ 10.6	27.8 ± 2.2
5/8	220 @ 246	8.7 @ 9.6	37.8 ± 2.2
1/2	194 @ 219	7.6 @ 8.6	47.8 ± 2.2
3/8	162 @ 193	6.4 @ 7.5	57.8 ± 2.2
1/4	130 @ 161	5.1 @ 6.3	67.8 ± 2.2
1/8	86 @ 129	3.4 @ 5.0	77.8 ± 2.2
empty	0 @ 85	0 @ 3.3	89.8 ± 2.2

Low-Level Oil Sensor

The sensor sends the signal to the low-oil level light in the fuel gauge.

The bottom of the sensor has a small reservoir with 2 small holes underneath to let the oil enter inside and 1 at the top to let the air enter to allow the oil flowing out.

Section 08 ELECTRICAL

Sub-Section 09 (INSTRUMENTS AND ACCESSORIES)

When there is enough oil inside the oil tank (and therefore in the sensor reservoir), the sensor detects the liquid and the light DOES NOT turn on.

When the oil level goes at a critical LOW level inside the oil tank (and therefore in sensor reservoir), the sensor detects the absence of liquid and the light turns on.

To check the oil sensor, unplug its connector and pull sensor out of oil tank.

Using an ohmmeter, check the continuity between the BLUE and BLUE / BLACK terminals.

When sensor is out of oil tank and its reservoir is empty, resistance must be infinite (open circuit).

Soak sensor in oil so that its reservoir fills up. Resistance must be 1 Ω max. (closed circuit).

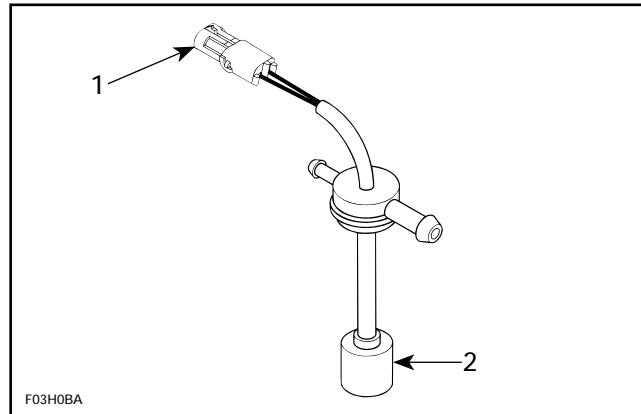
NOTE : Wait about 15-20 seconds before taking any reading to give the oil enough time to flow out or inside sensor reservoir.

SUMMARY	
TEST CONDITION	READING (W)
Sensor OUT of oil.	∞ (open circuit).
Sensor soaked IN oil.	1 Ω max. (closed circuit).

To reinstall sensor :

- Remove rubber seal from sensor.
- Install seal in oil tank sensor.
- Push sensor in seal.
- Plug connectors.

NOTE : This sensor turns the low-level oil light to ON if the connector has been forgotten unconnected even when there is enough oil in tank. This warns the operator that something is wrong.

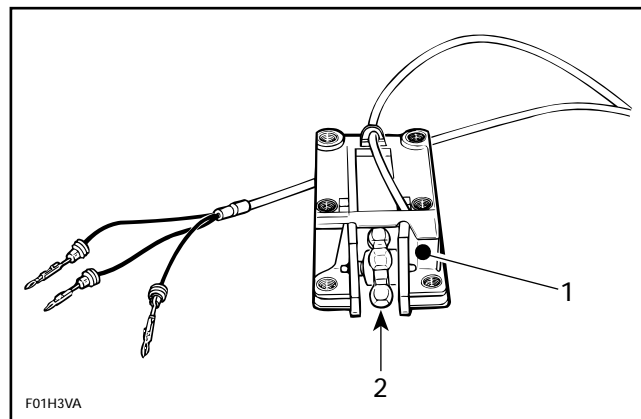


1. Measure resistance here
2. Sensor reservoir

Speed Sensor Verification (If Equipped)

The speedometer gives a reading through a speed sensor. Speed sensor is installed on ride shoe. It works with the water flow which turns a magnetic paddle wheel that triggers on electronic pick-up that in turn sends a speed signal to the speedometer.

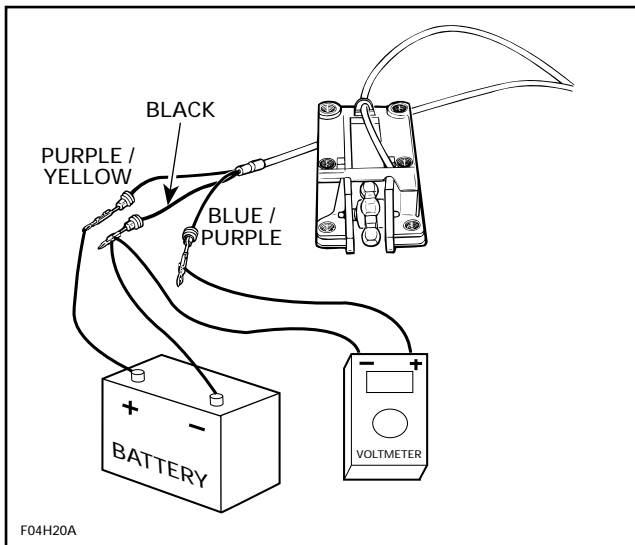
The paddle wheel is protected by the pick-up housing.



1. Pick-up housing
2. Paddle wheel

To verify speed sensor, use a voltmeter as follows :

- Disconnect speed sensor from inside the bilge.
- Provide a 12 Vdc to the sensor. Connect the + wire to the PURPLE / YELLOW wire and connect the - wire to the BLACK wire.
- Connect the voltmeter + probe to the BLUE / PURPLE wire and the - probe to the BLACK wire.
- Slowly turn the paddle wheel. You should read a voltage variation with the voltmeter



WIRING DIAGRAM

WIRE COLOR

First color of a wire is the main color. Second color is the tracer color.

Speedster Only

In the electrical system, basically the same wire colors are used for starboard (RH) and port (LH) sides. To differentiate sides, the starboard (RH) side wires have an additional GREEN tracer on the main wiring harness and on the MPEM (Multi-Purpose Electronic Module).

Ex. : YELLOW / BLACK is a YELLOW wire with a BLACK tracer. YELLOW / BLACK / RED is a YELLOW wire with a BLACK tracer and a RED tracer.

WIRE TERMINAL REMOVAL

To remove terminal from connector housing use Snap-on TT600-4 tool.

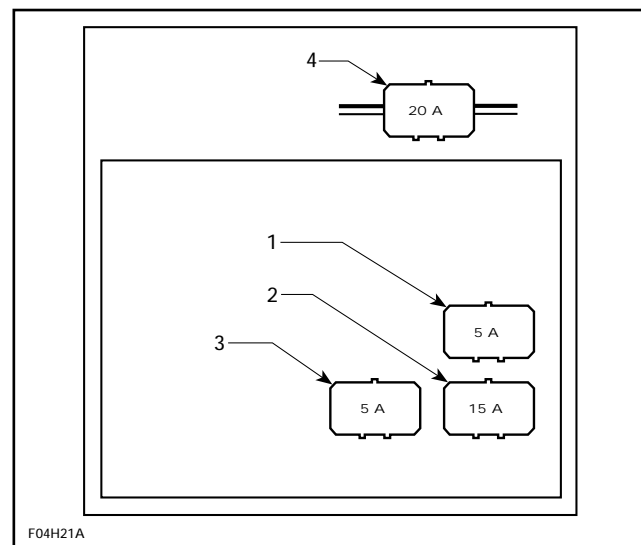
ACCESSORIES INSTALLATION

◆ **WARNING :** Never secure electrical wires /cables

with fuel lines. Keep wires away from any rotating, moving, heating, vibrating or sharp edge. Use proper fastening devices as required.

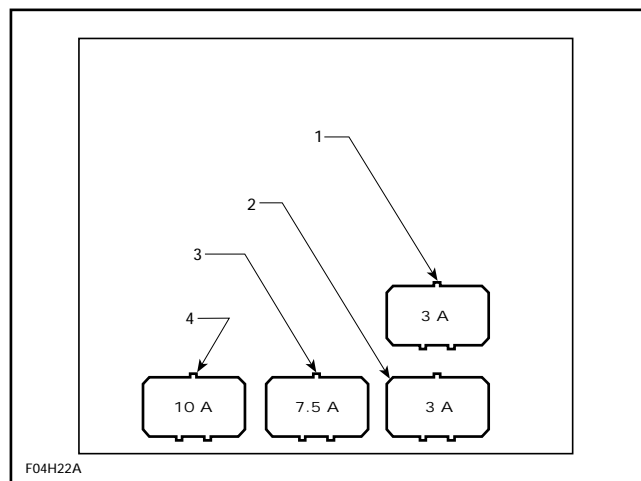
FUSES LOCATION

MPEM, Sportster / Challenger



1. Gauges
2. Charging system
3. MPEM supply
4. Fuse block supply

Fuse Block, All Models



1. Bilge pump
2. Nav / Anc lights
3. Blower
4. Accessories

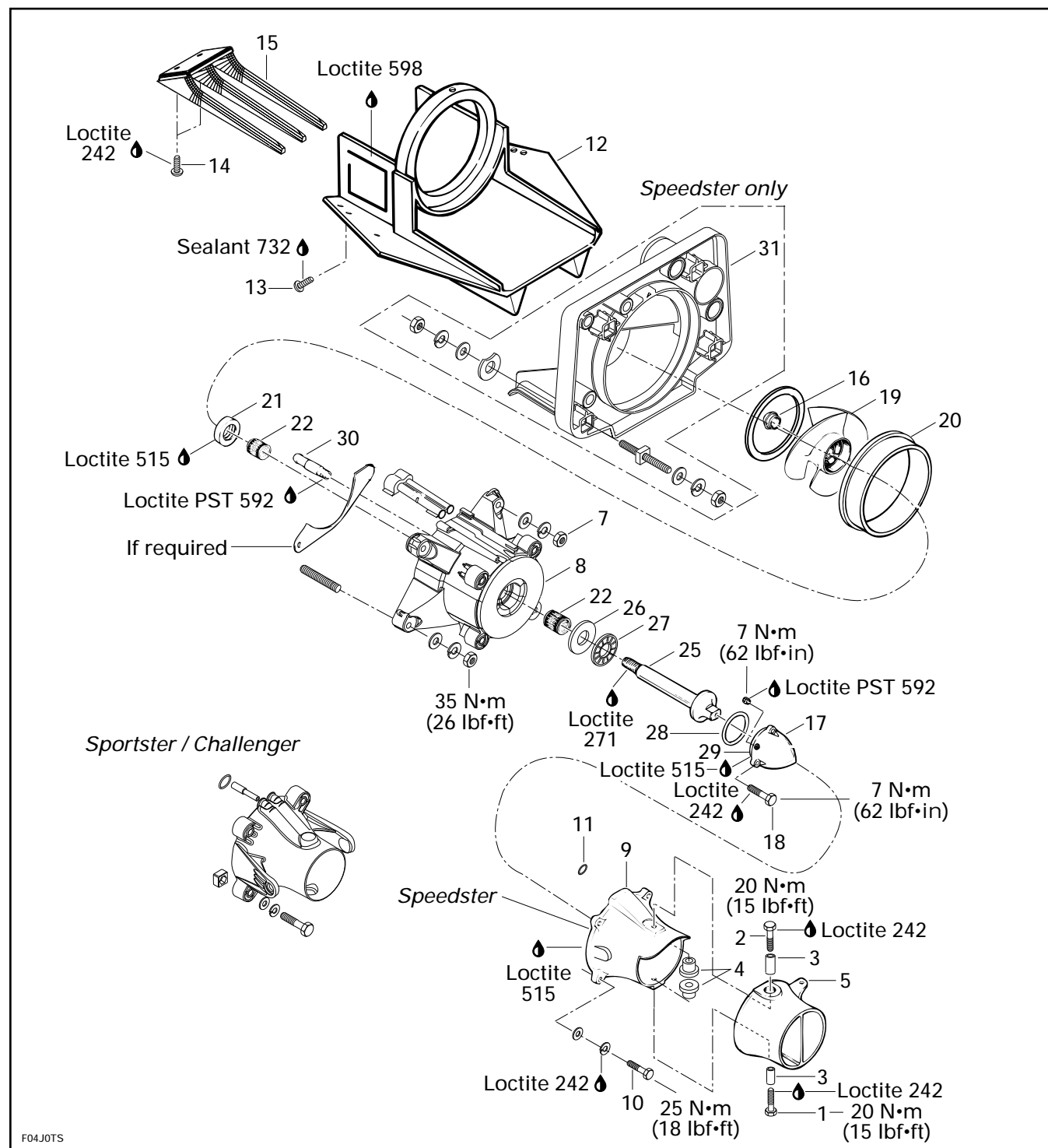
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PROPULSION AND DRIVE SYSTEMS

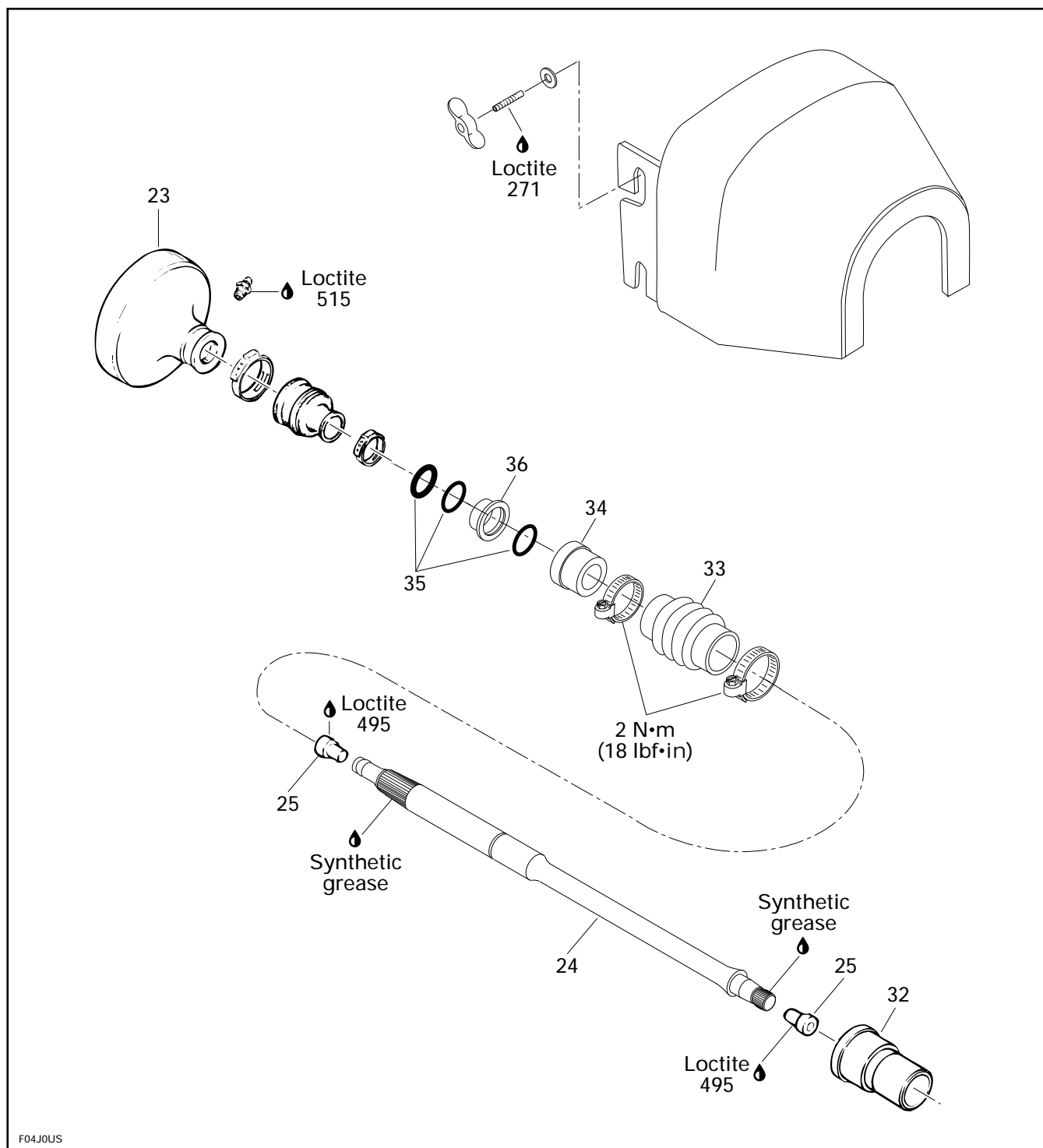
JET PUMP UNIT

All Models



F04J0TS

DRIVE SHAFT AND SEAL CARRIER



GENERAL

Some pump components can be changed to improve boat performance in high altitude regions between 1500 - 3000 m (5000 - 10 000 ft). Refer to the service department for the latest specifications.

▼ **CAUTION :** Such modifications should only be performed by experience mechanics since they can greatly affect vehicle performance.

JET PUMP INSPECTION ON JET BOAT

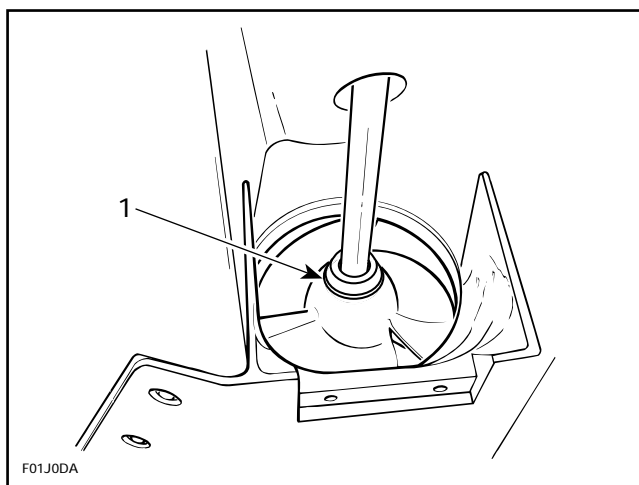
To work on boat, securely install it on a stand. Thus, if access is needed to water inlet area, it will be easy to slide underneath boat.

A lift kit (P / N 295 000 120) can be used to install boat on a stand.

Impeller Condition and Impeller / Wear Ring Clearance

Impeller Condition

Condition of impeller, boot and ring can be quickly checked from underneath of the jet boat. Remove grill and look through water inlet opening.

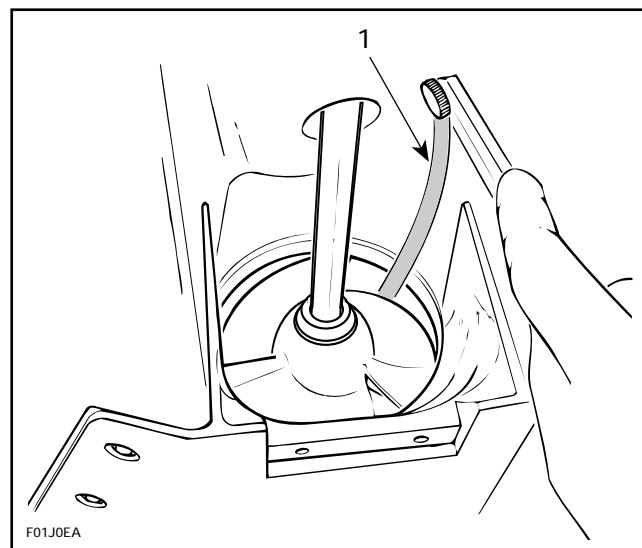


1. Boot with ring

Impeller / Wear Ring Clearance

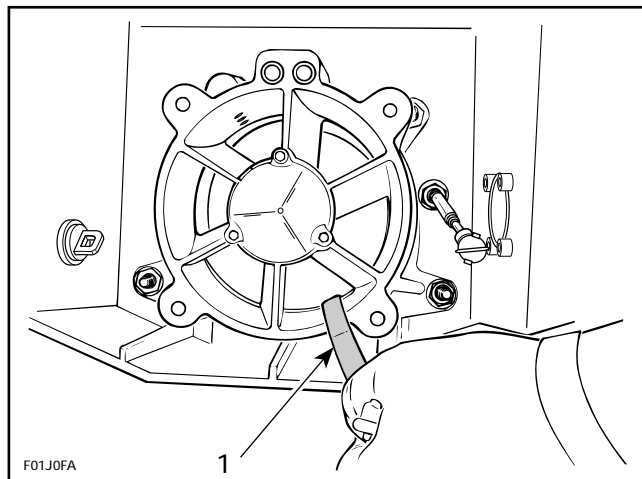
This clearance is critical for jet pump performance.

Clearance can be checked from water inlet opening, after inlet grill removal, or from venturi side, after venturi / nozzle assembly removal.



MEASURING FROM WATER INLET SIDE

1. Feeler gauge



MEASURING FROM VENTURI SIDE

1. Feeler gauge

Using a long feeler gauge 30 cm (12 in) blades, measure clearance between impeller blade tip and wear ring. Measure each blade at its center. Clearance should not exceed 1.02 mm (.040 in). If clearance is greater, disassemble jet pump and inspect impeller and wear ring. Renew worn parts.

Oil Inspection

Detach adjuster of steering cable from nozzle.

Detach ball joint of VTS from trim ring (**Challenger**).

Detach ball joint of shifter cable from reverse gate.

Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)

Remove reverse gate support (with gate), venturi and nozzle assembly from impeller housing.

Remove housing cover plug.

Check oil level, it should be at bottom of hole threads.

If oil level is low, check impeller shaft housing for leaks. A pressure test must be performed. Refer to **pump pressurization** in this section.

To check oil condition, insert a wire through opening then withdraw. A whitish oil indicates water contamination.

This may involve defective impeller shaft seal and / or O-ring of housing cover. Jet pump unit should be overhauled to replace seal.

If everything is correct, apply Loctite PST 592 on plug and reinstall it on cover. Properly reinstall removed parts.

Oil Replacement

Remove parts as described in **Oil Inspection**.

Remove 3 screws retaining cover.

Using a fiber hammer, gently tap cover to release it from housing cover.

Thoroughly clean reservoir and inside of cover with a solvent.

Apply Loctite 518 and reinstall cover with its O-ring. Remove plug from cover.

Pour approximately 90 mL (3 oz) of oil through hole until oil reaches the bottom of hole threads. Use SEA-DOO JET PUMP SYNTHETIC OIL (P / N 293 600 011) only. Oil will penetrate slowly in housing, wait a few minutes and readjust oil level.

▼ **CAUTION :** This is a synthetic oil. Do not mix with mineral based oil. Do not mix oil brands.

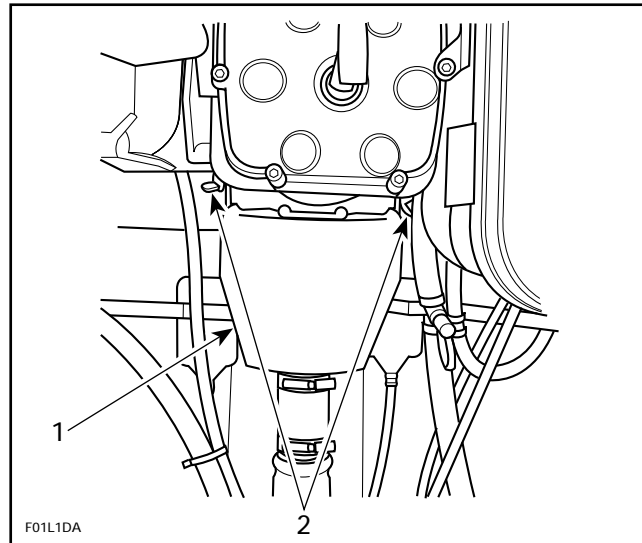
Apply Loctite PST 592 on plug and reinstall it on cover.

Properly reinstall removed parts.

JET PUMP REMOVAL

Remove PTO flywheel guard.

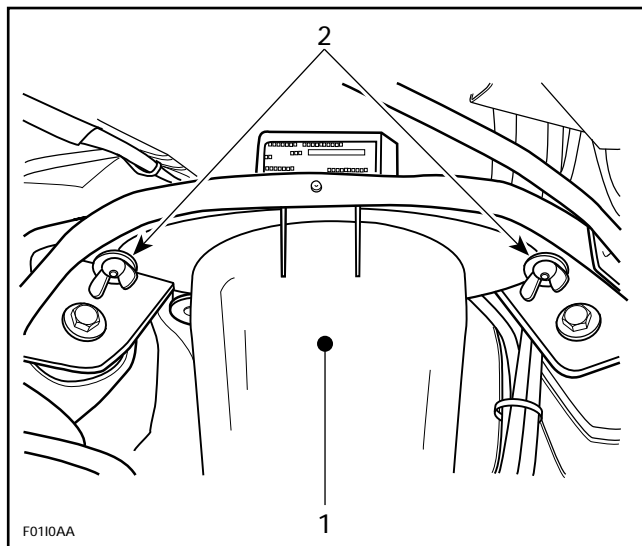
Sportster and Speedster



TYPICAL

1. PTO flywheel guard
2. Wing nuts

Challenger Model



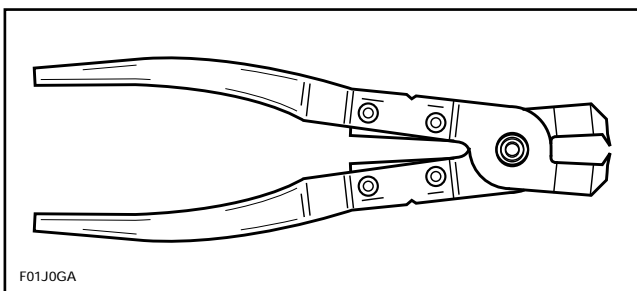
1. Flywheel guard
2. Wing nuts

Unfasten **small** clamp on drive shaft boot as follows :

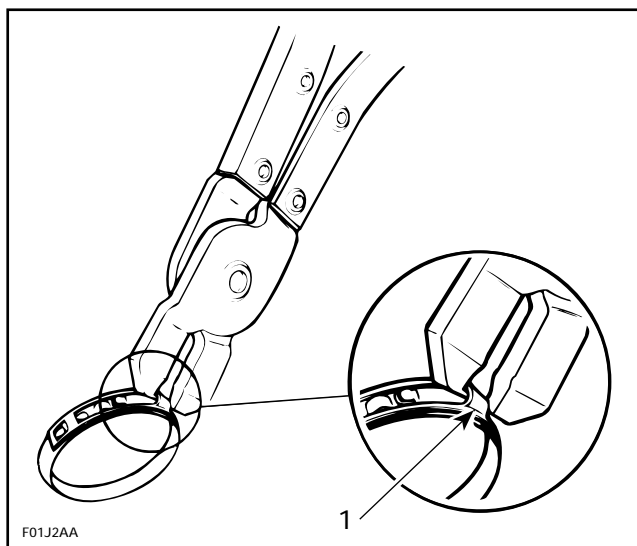
- Use pliers (P / N 295 000 069).

Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)

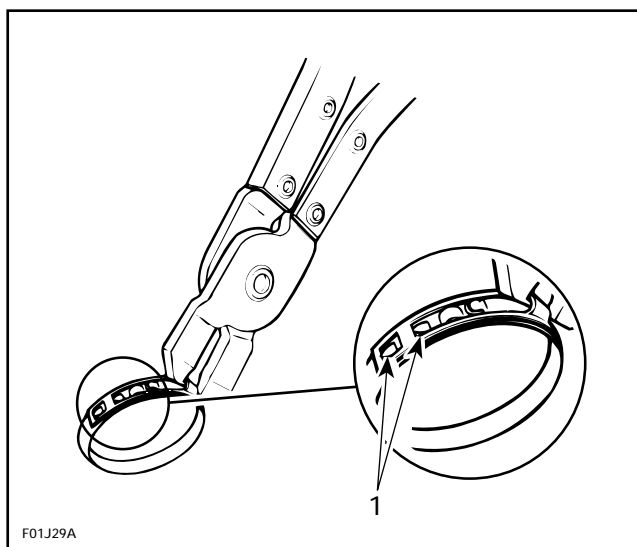


- Insert pointed tips of pliers in closing hooks.

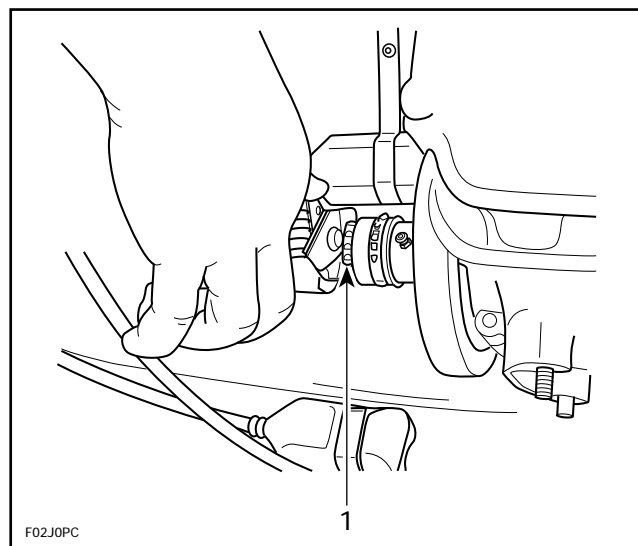


1. Closing hooks

- Squeeze pliers to draw hooks together and disengage windows from locking hooks.



1. Locking hooks

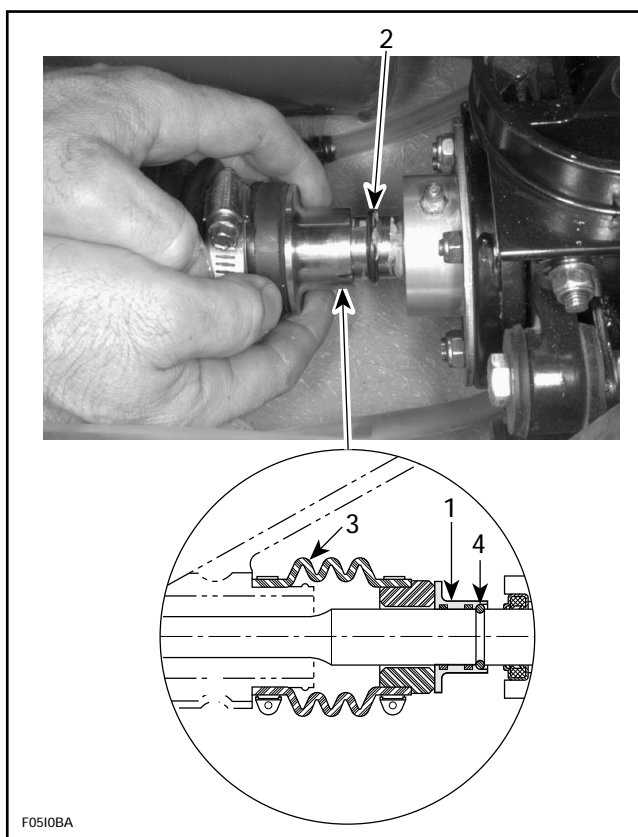


TYPICAL

1. Unfasten small clamp

- Keep clamp for later use.

Hold floating ring and compress protective boot ; then, pull out O-ring from driveshaft groove.



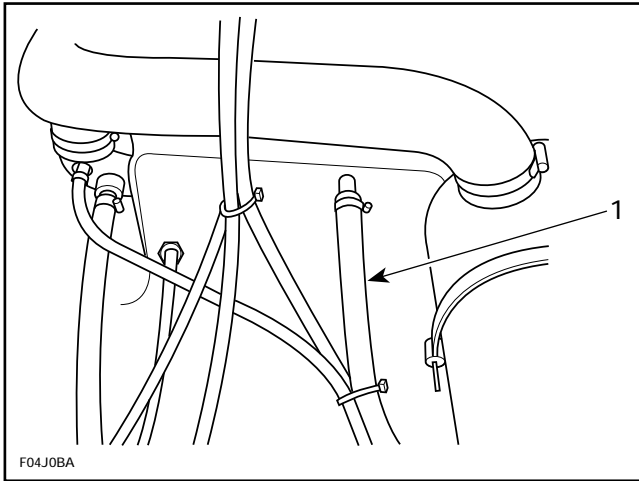
TYPICAL

1. Floating ring
2. O-ring
3. Protective boot
4. Remove this O-ring

Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)

From inside bilge, disconnect coolant inlet hose from impeller housing.



TYPICAL

1. Coolant inlet hose

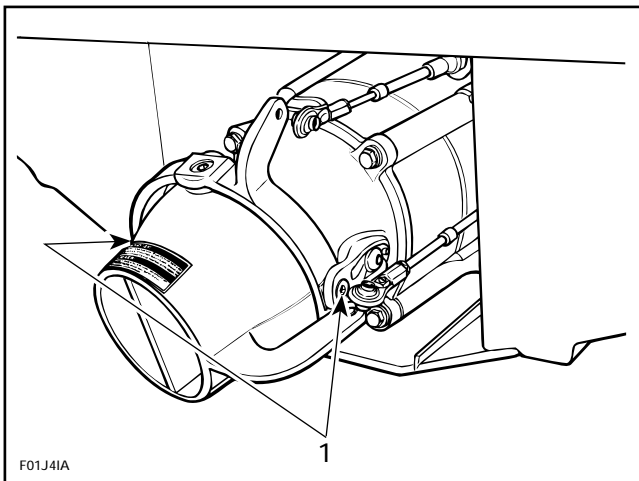
Disconnect adjuster of steering cable from nozzle. Remove ball joint fasteners to release reverse cable from reverse gate.

Detach ball joint of VTS from trim ring (Challenger).

1,2,3,4,5, Screw, Sleeve, Bushing and Nozzle

Remove 2 retaining screws and withdraw nozzle. Push sleeves and bushings out of nozzle.

On challenger, withdraw nozzle / trim ring assembly by removing 2 retaining screws of trim ring.



TYPICAL

1. Remove screws

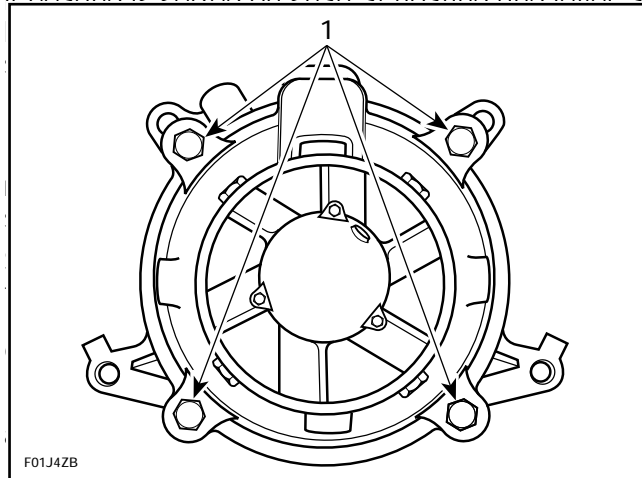
7,8, Nut and Impeller Housing

Remove nuts retaining impeller housing to hull.

Withdraw pump unit and drive shaft together.

CAUTION : When removing pump unit, a shim could have been installed between hull and pump housing, be careful not to damage shim. If shim is not reinstalled engine and jet pump alignment will be altered.

If the drive shaft is jammed into PTO flywheel or if bearing is seized on shaft at floating ring level, a



TYPICAL

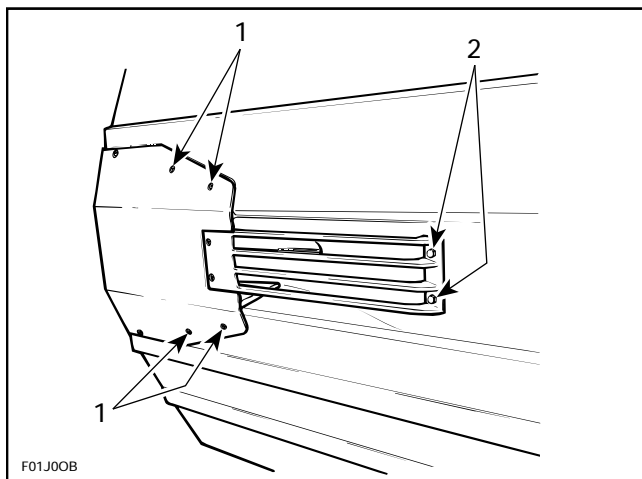
1. Remove screws

12,13,14,15, Ride Shoe, Screw and Grill

NOTE : An impact screwdriver can be used to loosen tight screws of grill.

Remove retaining screws of grill then withdraw it.

Remove retaining screws of ride shoe.

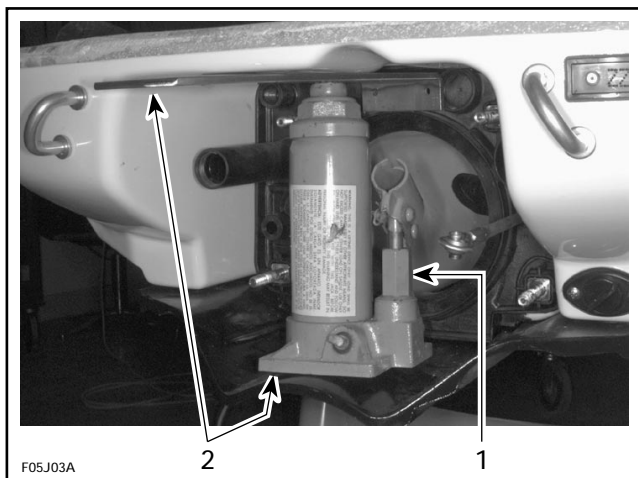


TYPICAL

1. Ride shoe screws
2. Grill screws

An hydraulic jack can be used to remove ride shoe.

Place a steel plate on ride shoe and a long piece of wood underneath swim platform. Shim as necessary for proper jack installation.



TYPICAL

1. Hydraulic bottle jack
2. Steel plate

Pump jack until ride shoe unsticks from hull.

▼ **CAUTION** : Prying ride shoe is likely to be damageable. Proceed with care. Ride shoe may be heated with a heat gun to weaken silicone bond.

31, Jet Pump Support

Speedster

○ **NOTE** : To remove the jet pump support, ride shoe must be removed first. Since the support is used to seal the hull and thus easing pump removal, the support should not be removed needlessly.

Remove ball joints, boots, nuts, half rings and O-ring from cables.

From inside of hull, disconnect water supply hose from its fitting. Remove fasteners retaining support to hull.

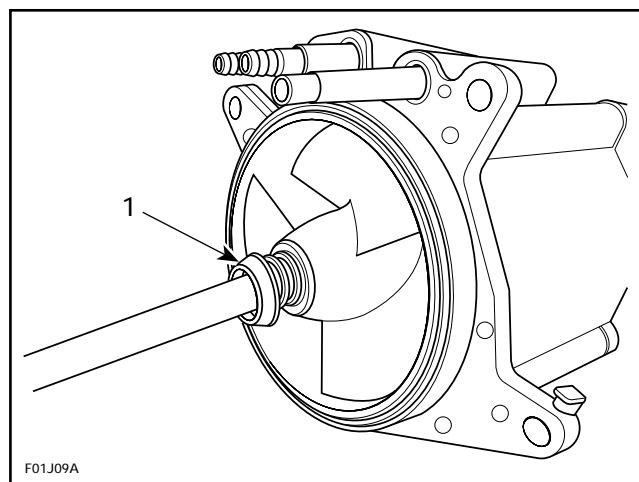
Using a heat gun, heat support until it can be pulled off.

JET PUMP DISASSEMBLY

○ **NOTE** : Whenever removing a part, visually check for damage such as : corrosion, crack, split, break, porosity, cavitation, deformation, distortion, heating discoloration, wear pattern, missing plating, missing or broken needle on needle bearing, water damage diagnosed by black-colored spots, etc. Renew any damaged part. As a quick check, manually feel clearance and end play, where applicable, to detect excessive wear.

16, Boot

Pull out ring from boot.



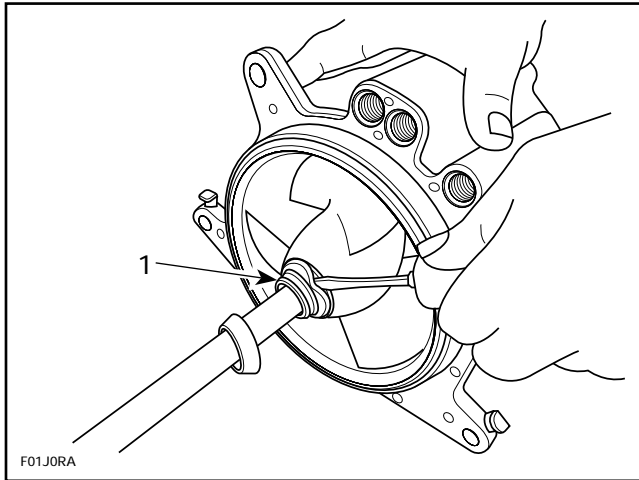
TYPICAL

1. Pull out ring

Insert a screwdriver blade between impeller and boot flange. Carefully pry boot all around to release from impeller. To ease this operation, apply liquid soap between boot and impeller, as they begin to separate.

Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)

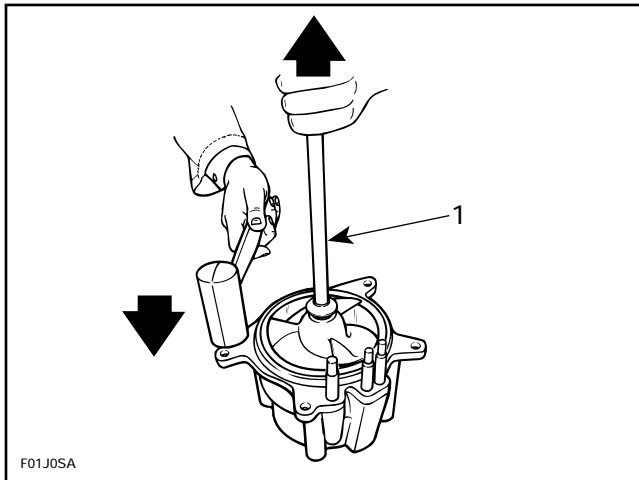


TYPICAL

1. Pry boot cut

Withdraw drive shaft.

NOTE : A jammed drive shaft can be removed by holding pump unit by drive shaft, slightly raised unit above a smooth surface, then strike all around of impeller housing with a fiber hammer. Corroded parts can be loosened by applying BOMBARDIER LUBE (P / N 293 600 006) lubricant.



TYPICAL

1. Hold raised with drive shaft while striking

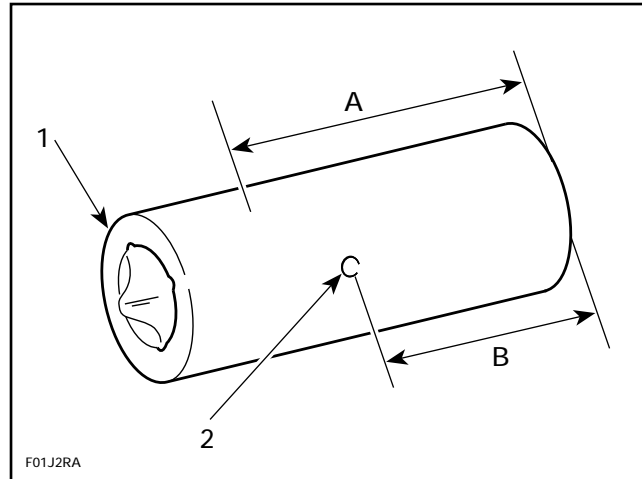
30, Fitting

Fitting can be removed with deep socket or vise grip. Do not touch hose mounting area.

Fitting can be removed from pump housing with following suggested tool :

- Use a 14 mm (9/16 in) deep socket.

- Drill deep socket with a 14 mm (9/16 in) drill bit, starting at hexagon head end as shown in following illustration.
- Drill a 2.40 mm (3/32 in) hole in center of deep socket as shown in following illustration.
- Install 2.40 mm (3/32 in) roll pin in the center hole.



1. Deep socket 14 mm (9/16 in)
2. Roll pin 2.40 mm (3/32 in)
A. 42.50 mm (1-43/64 in)
B. 36.80 mm (1-29/64 in)

17,18, Housing Cover and Screw

With pump assembly in horizontal position, remove 3 retaining screws.

Place container under cover to catch oil.

Using a fiber hammer, gently tap cover to release it from impeller housing.

19, Impeller

Insert impeller shaft holder (P / N 295 000 082) on impeller shaft flat end.

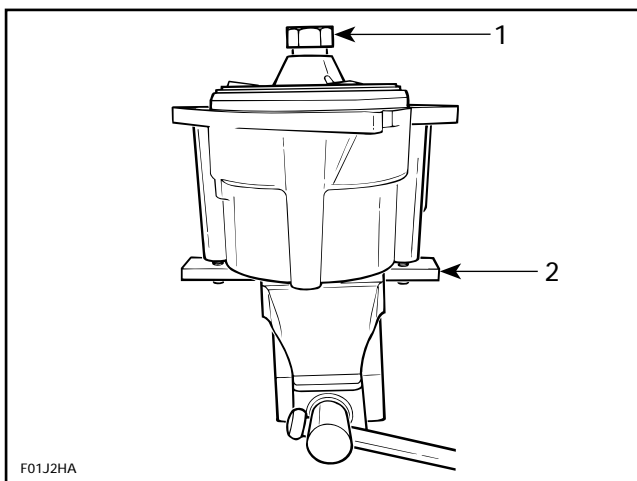
Using 2 screws previously removed from venturi, secure shaft holder to housing. To ease removal heat impeller center with a propane torch to approximately 150° C (300° F) to break the Loctite bond.

Impeller is loosen using impeller remover tool (P / N 295 000 001).

Install shaft holder in a vice.

Insert special tool in impeller splines.

Rotate impeller remover tool counterclockwise and unscrew completely impeller.



1. Impeller remover installer tool
2. Impeller shaft holder tool

▼ **CAUTION :** Never use any impact wrench to loosen impeller.

To remove impeller, apply a rotating movement and pull at same time. Slide impeller out of housing and remove tool from impeller.

Remove 2 screws holding impeller housing to shaft holder.

Lift impeller housing away from impeller shaft.

Slide thrust washer and thrust bearing off from shaft.

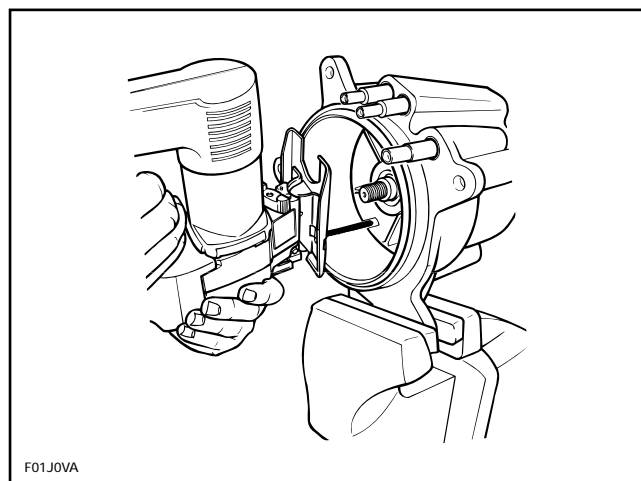
20, Wear Ring

Place impeller housing in a brass jaw vise so that it is firmly retained by a lug.

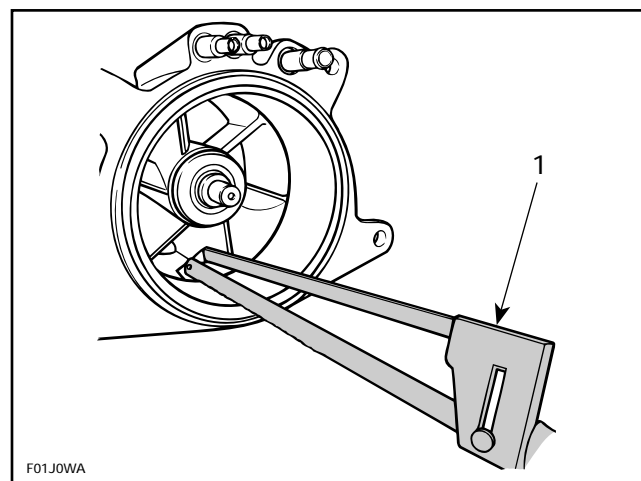
Cut wear ring at 2 adjacent places.

○ **NOTE :** Wear ring can be cut using a jigsaw, a small buffer or a low clearance hacksaw such as Snap-on HS3 or equivalent.

▼ **CAUTION :** When cutting ring, be careful not to damage impeller housing.



TYPICAL



1. Snap-on HS3

After cutting ring, insert a screwdriver blade between impeller housing and one end of ring.

Lift ring end so that both ends overlap each other.

Pull ring out.

21, Seal

To remove seal, proceed as follows :

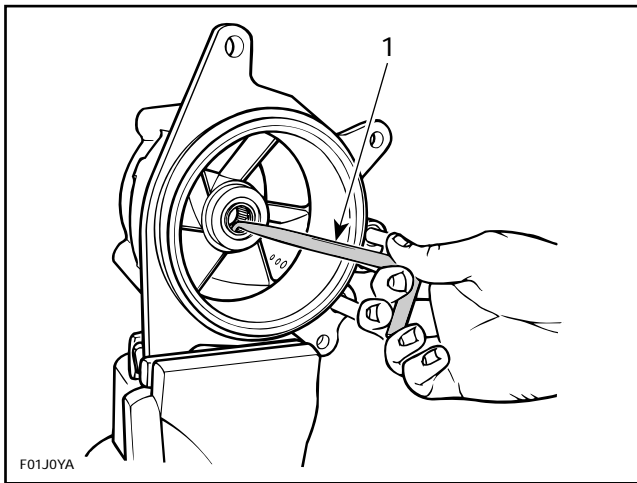
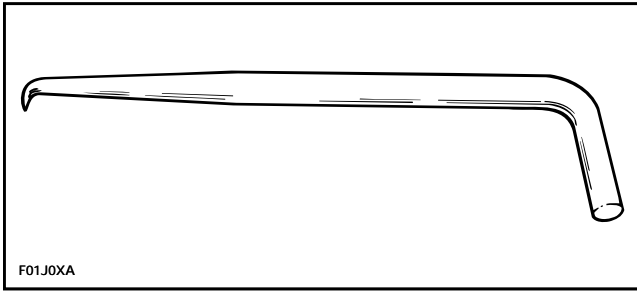
▼ **CAUTION :** It is not recommended to push seal out with a punch. Housing and / or bearing(s) could be damaged.

Seal should be removed using the following suggested tool.

Seal puller, Snap-on no. S6129.

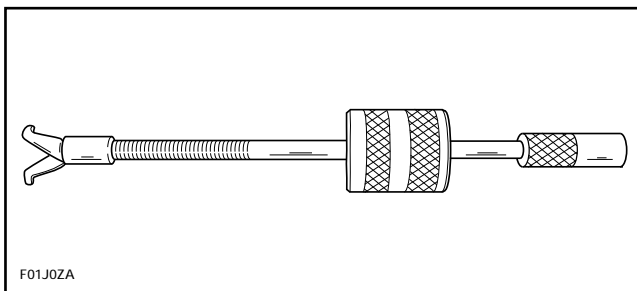
Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)



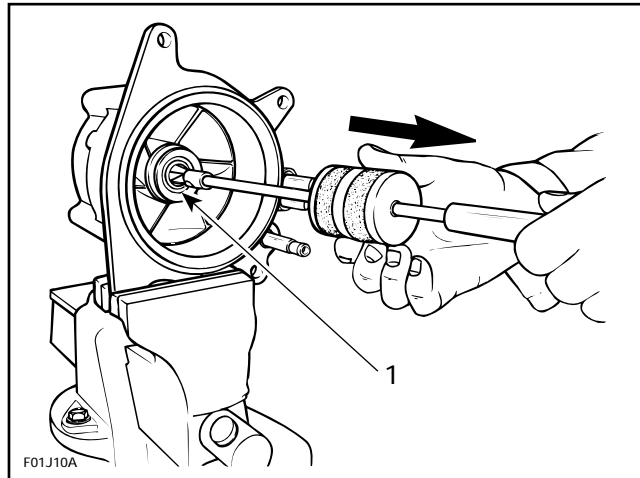
1. Pulling seal out of housing

Or, use a Snap-on hammer puller including :
HandleCJ93-1
HammerCJ125-6
ClawsCJ93-4



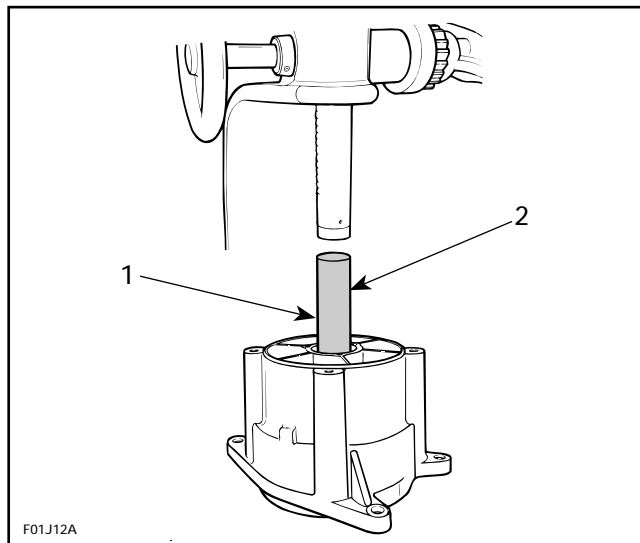
Close puller claws so that they can be inserted between seal and bearing. Holding claws, turn puller shaft clockwise so that claws open and tighten against seal.

Slide puller sleeve outwards and gently tap puller end. Work with small strikes otherwise claws will slip out. As soon as seal begins to slide out, re-tighten claws to always maintain them tight against seal. Continue pulling until seal is out.



1. Pulling seal out of housing

NOTE : If bearings and seal need to be renewed, the special pusher described further on in bearing removal can be used. Simply insert pusher from the rear and push towards the front.



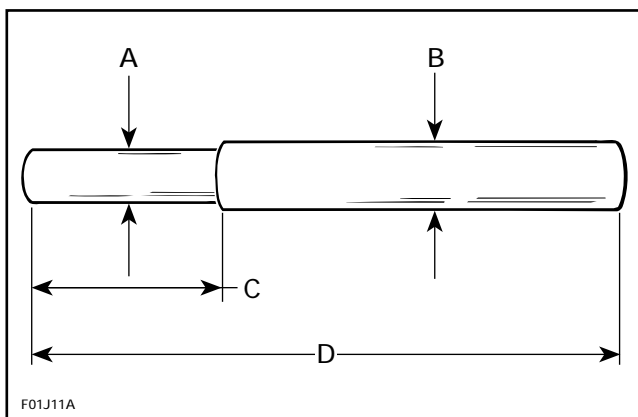
1. Same tool for bearing removal
2. Removing seal and bearings out from rear

22, Needle Bearing

NOTE : It is always recommended to renew both bearings, even if only one needs to be replaced.

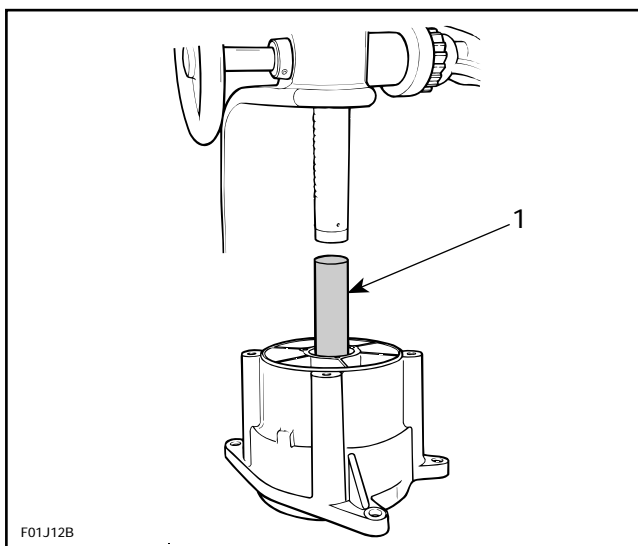
Bearings can be easily removed with the following suggested pusher.

Use a 30 mm dia. x 345 mm long (1-1/8 dia. x 13-1/2 in) steel shaft. Machine shaft as per the following drawing.



- A. 22 mm (.865 in) dia.
B. 28 mm (1.115 in) dia.
C. 90 mm (3-1/2 in)
D. 345 mm (13-1/2 in)

Insert pusher into one bearing then push tool using a arbor press until bearings are out. However, care should be taken not to damage bearing journals.



1. Press bearings out

CLEANING

NOTE :Cooling supply fitting can be removed to ease cleaning of impeller housing mating surface (not required on Speedster).

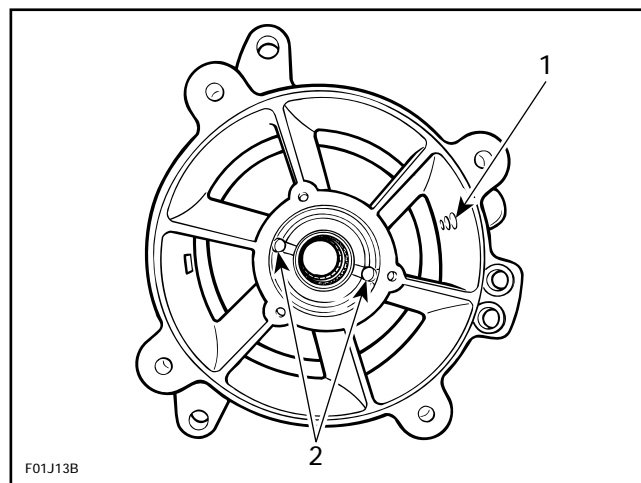
Sealant can be removed with a steel brush (disc) mounted on a drill or a scraper.

Bombardier stripper (P / N 295 500 110) can be used to remove remaining sealant. Carefully apply on mating surface taking care not to exceed this area because paint will be damaged. Let product dissolve sealant then scrape it.

Properly clean all threads.

Discard all O-rings and clean parts in a solvent.

Carefully check water passages (Cooling system) and oil passages. Blow low pressure compressed air through them and make sure they are not clogged.



1. Water passages
2. Oil passages

PARTS INSPECTION

33,34,35,36, Protective, Boot, Carbon Ring, O-Ring and Floating Ring

Inspect carbon ring for wear at the inside and at the flange where it contacts the floating ring.

Inspect the floating ring flange where it contacts the carbon ring.

Inspect O-rings and protective boot for cracks, cuts etc.

Replace parts as necessary.

19,23,24, Impeller, PTO Flywheel and Drive Shaft

Visually inspect drive shaft splines, impeller and PTO flywheel. Check for wear or deformation. Re-new any damaged part.

NOTE :If PTO flywheel splines are very worn, a pipe wrench can be used to remove PTO flywheel instead of special tool (P / N 295 000 001). Refer to ENGINE 04-03 then look for PTO flywheel and magneto.

Inspect drive shaft protector tube condition. Check inside of tube and its retaining tabs. Replace tube as necessary.

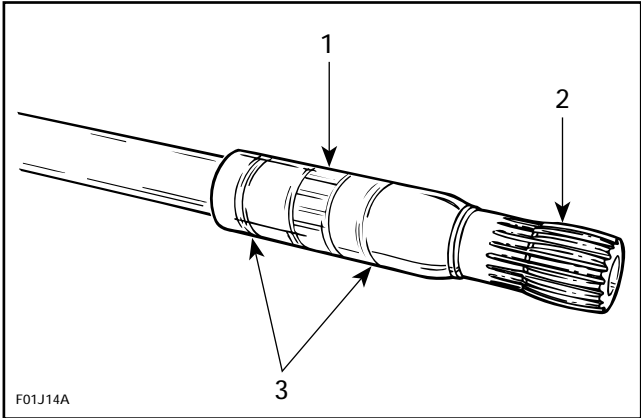
24,25,34, Drive Shaft, Carbon Ring and Damper

Wear

Visually inspect shape of dampers for deformation or other damage. Ensure they are firmly retained.

Inspect carbon ring and its contact surface. Check for scoring, pitting, chipping or other evidence of wear.

With a finger nail, feel contact surfaces of bearing and seals. If any irregular surface is found, renew drive shaft.



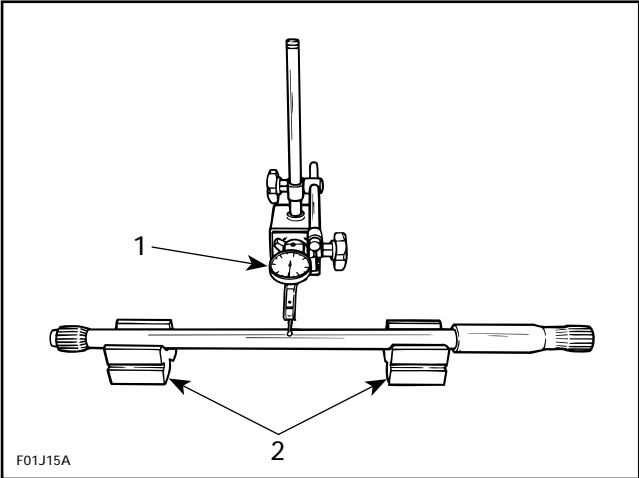
- 1. Carbon ring contact surface
- 2. Splines condition
- 3. Seal contact surface

Deflection

Excessive deflection could cause vibration and damage to drive shaft splines, impeller, flywheel or seal carrier.

Install drive shaft in V-blocks and set a dial gauge in center of shaft. Slowly rotate shaft ; difference between highest and lowest dial gauge reading is deflection. Refer to the following illustration.

Maximum permissible deflection is 0.5 mm (.020 in).



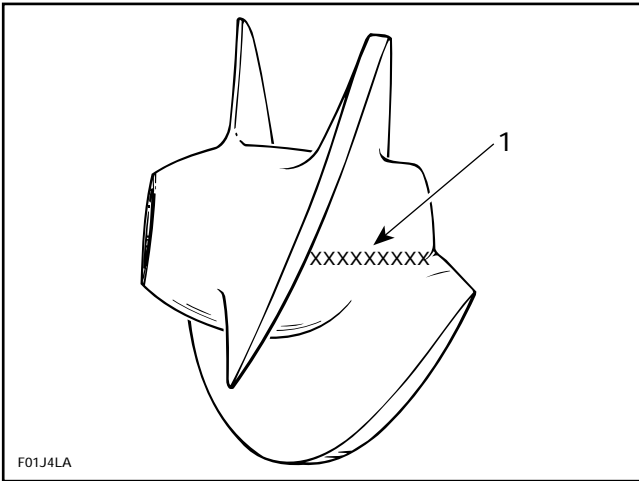
MEASURING DRIVE SHAFT DEFLECTION

- 1. Dial gauge
- 2. V-blocks

19, Impeller

Identification

To identify the impellers refer to the following illustration and chart.



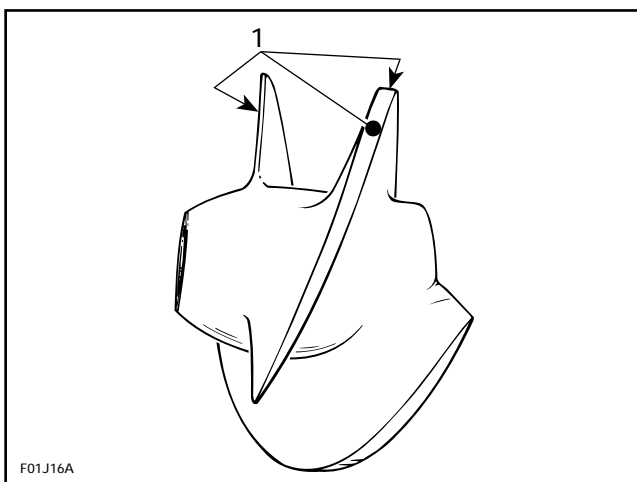
- 1. Stamped part number

BOAT MODEL	IMPELLER P / N	MATERIAL	PITCH
SPORTSTER	271 000 470	Stainless steel	Progressive pitch 11° - 25°
CHALLENGER	271 000 620	Stainless steel	Progressive pitch 11° - 25°
SPEEDSTER	—	Stainless steel	Progressive pitch —

19,20, IMPELLER AND WEAR RING

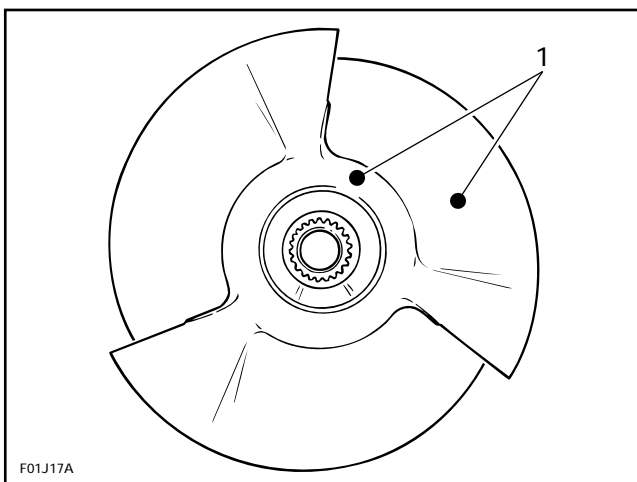
Examine impeller in wear ring for distortion.

Check if blade tips are blunted round, chipped or broken. Such impeller is unbalanced and will vibrate and damage wear ring, impeller shaft, shaft seal or bearings. Renew if damaged.



1. Replaced if blunted round or damaged

Check impeller for cavitation damage, deep scratches or any other damage.



1. Check for cavitation, deep scratches or other damage

Check wear ring for deep scratches, irregular surface or any apparent damage.

If impeller / wear ring clearance is too large and impeller is in good shape, renew wear ring.

22,25, Needle Bearing and Impeller Shaft

Wear

Inspect needle bearings and their contact surface. Check for scoring, pitting, chipping or other evidence of wear.

With a finger nail, feel contact surface of seal. If any irregular surface is found, renew impeller shaft.

Install bearings then install impeller shaft and rotate it. Make sure it turns smoothly.

Radial Play

Radial play is critical for jet pump unit life span.

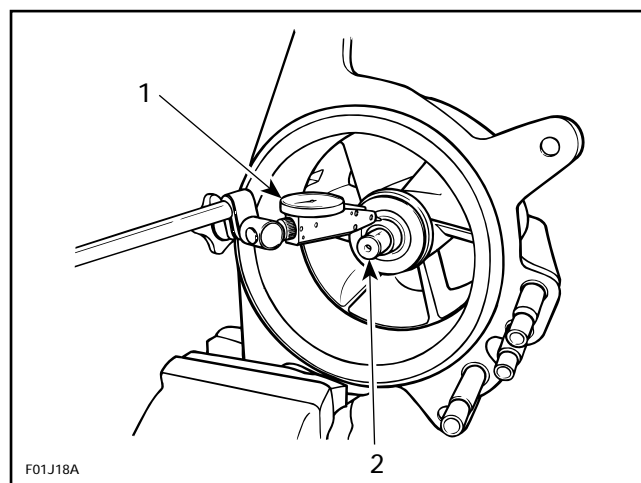
Radial play of impeller shaft is checked with shaft in housing, without impeller.

Retain housing in a brass jaw vise making sure not to damage housing lug.

Set a dial gauge and position its tip onto shaft end, close to end of threads.

Move shaft end up and down. Difference between highest and lowest dial gauge reading is radial play.

Maximum permissible radial play is 0.05 mm (.002 in).



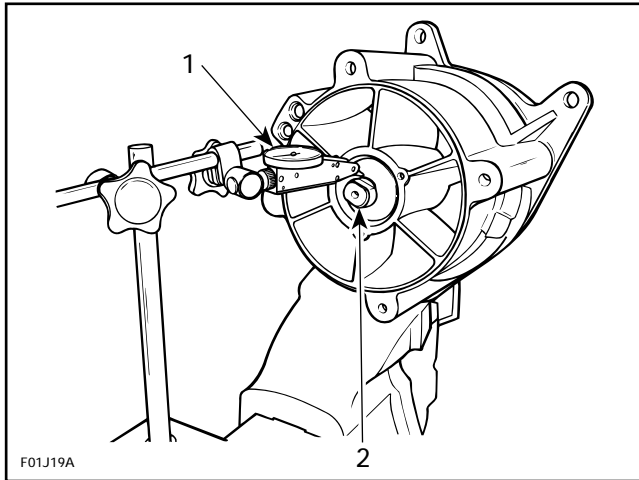
MEASURING IMPELLER SHAFT RADIAL PLAY

1. Dial gauge
2. Measure close to threads at shaft end

To check both bearings, proceed the same way with other shaft end. Position gauge tip on diameter, close to flats on shaft.

Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)



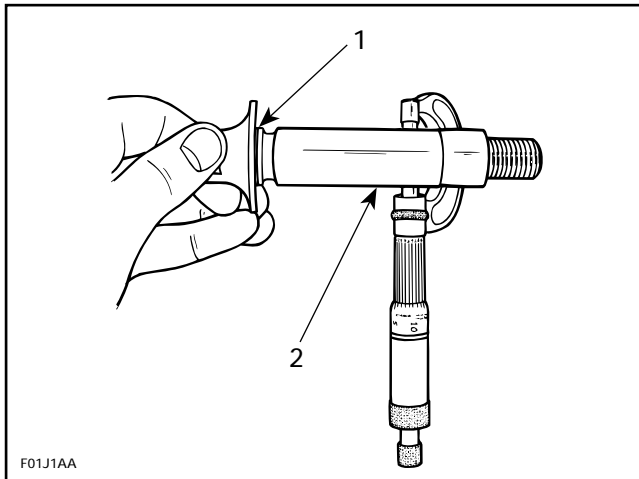
MEASURING IMPELLER SHAFT RADIAL PLAY

1. Dial gauge
2. Measure close to flats at shaft end

Excessive play can come either from worn bearings or impeller shaft or damaged impeller housing bearing surfaces.

Measuring shaft diameter will determine defective part.

Using a micrometer, measure diameter on bearing contact surfaces. Minimum shaft diameter should be 22.24 mm (.876 in).

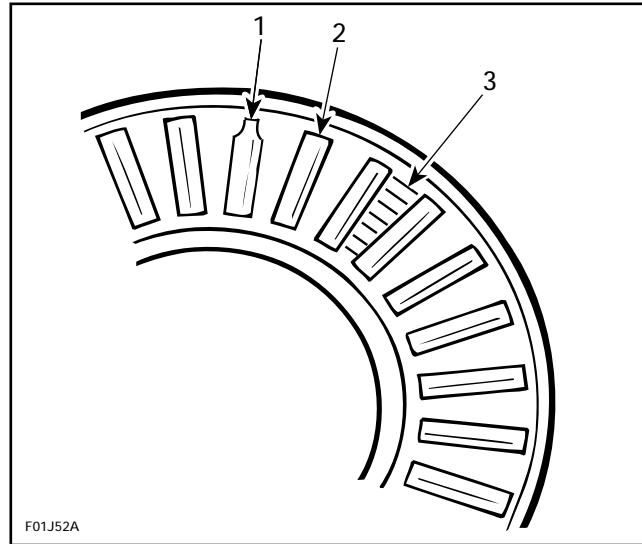


1. Inspect for wear at the bearing pilot
2. Radial bearing raceway

NOTE :If shaft is to be replaced, it is recommended to replace both bearings at the same time. In addition, it is suggested to replace thrust bearing and thrust washer.

26,27, Thrust Washer and Thrust Bearing

Visually inspect thrust washer, thrust bearing and their contact surface. Check for scoring, pitting, flaking, discoloration or other evidence of wear.



TYPICAL

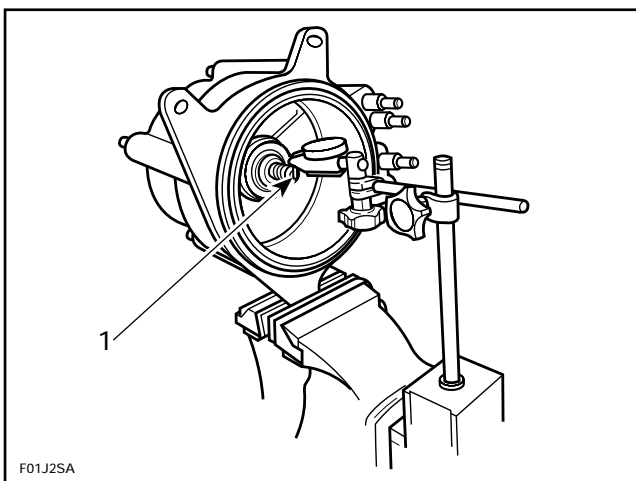
1. Worn roller (trunnion worn on end of roller)
2. Good roller (cylindrical shape)
3. Lock for scoring on retainer

NOTE :When replacing either washer or bearing, it is recommended to renew both.

17,25, Housing Cover and Impeller Shaft End Play

End play of impeller shaft is checked with shaft in housing, without impeller and with housing cover installed.

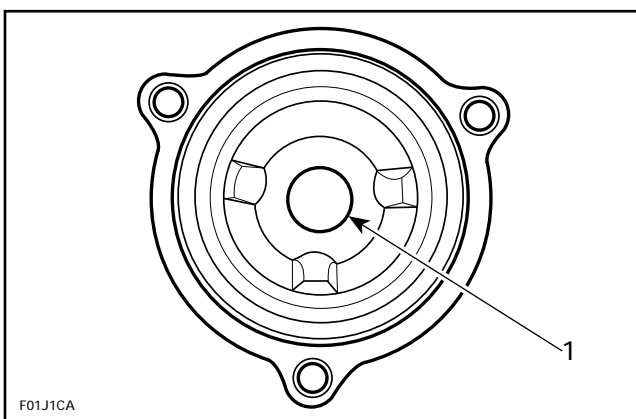
Retain housing in a brass jaw vise making sure not to damage housing lug. Set a dial gauge and position its tip on the end of shaft. Move shaft end by pulling and pushing. Difference between highest and lowest dial gauge reading is end play. Maximum permissible end play (new) is 0.12 - 0.54 mm (.005 - .021 in).



1. Tip on shaft end

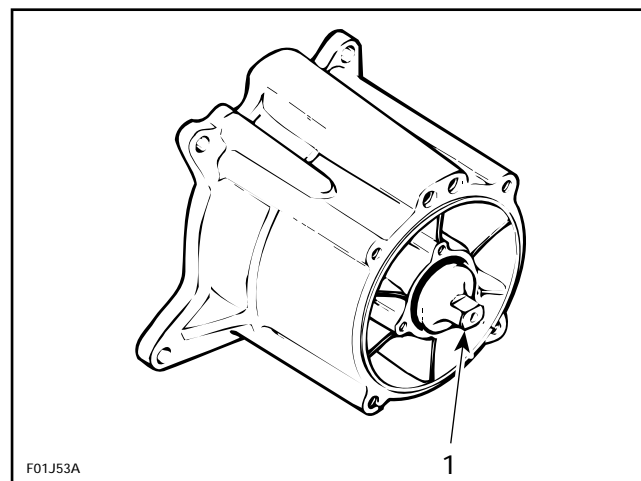
Excessive play comes from worn protrusion inside housing cover and wear of impeller shaft nose.

Visually inspect protrusion inside cover. If worn, a small peak in center will be apparent.



1. End stop

Inspect impeller shaft nose for wear.



1. Impeller shaft nose

21, Seal

Carefully inspect seal lips. Make sure that lips are not worn, distorted, cracked or present any other damages. Renew as necessary.

JET PUMP ASSEMBLY

Speedster Only

The jet pump and all its components are the same on port and starboard (LH / RH).

However, there are different ride shoes, intake grill on port and starboard (LH / RH).

20, Wear Ring

The wear ring features a lip on one edge ; position lip outwards of housing.

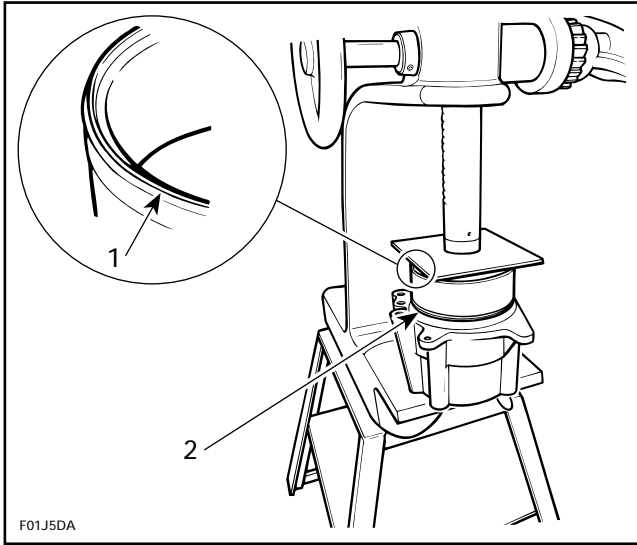
NOTE : To ease insertion into housing, apply a soapy solution (P / N 293 600 006) onto outside circumference of wear ring.

To install ring in housing, use a square steel plate approx. 180 x 180 mm x 6 mm thick (7 x 7 in x 1/4 in) and a press.

Manually engage ring in housing making sure it is equally inserted all around. Press ring until it seats into bottom of housing.

Section 09 PROPULSION AND DRIVE SYSTEMS

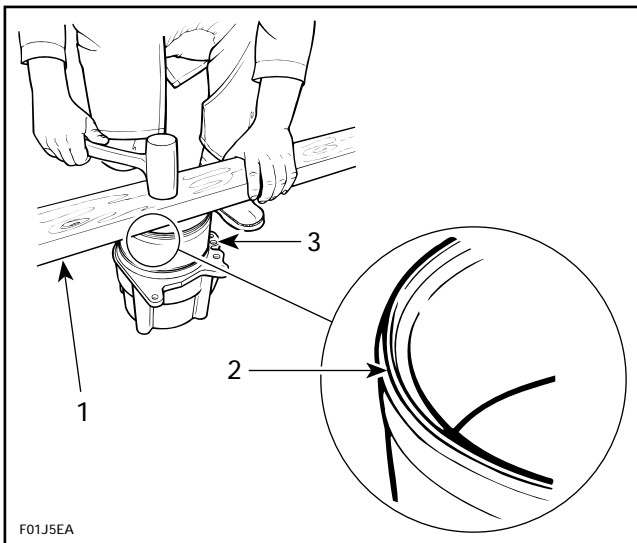
Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)



1. Seal lip
2. Press wear ring

If a press is not readily available, a piece of wood such as a 2 x 4 x 12 in. long, can be used.

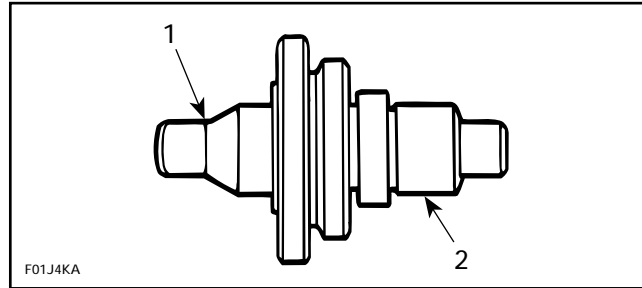
Manually engage ring in housing making sure it is equally inserted all around. Place wood piece over ring. Using a hammer, strike on wood to push ring. Strike one side then rotate wood piece about 90° and strike again. Frequently rotate wood piece so that ring slides equally all around until it seats into bottom of housing.



1. Piece of wood
2. Seal lip here
3. Wear ring

21,22, Seal and Needle Bearing

Bearings and seal will be properly installed in housing using bearing / seal installer tool (P / N 295 000 107).

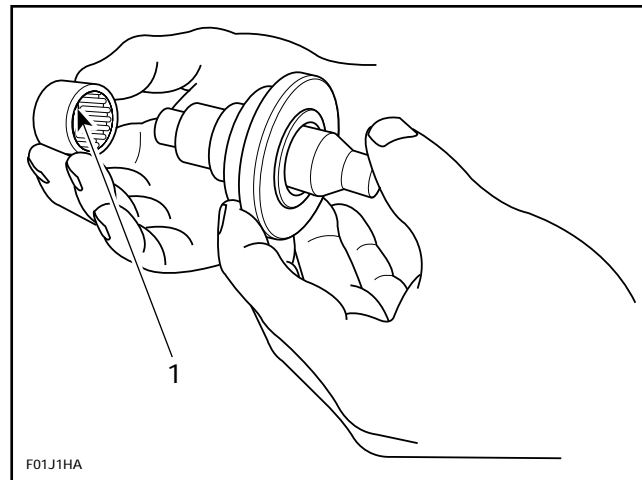


BEARING / SEAL INSTALLER TOOL

1. Seal end
2. Bearing end

Stamped end of bearings (showing identification markings) must be located toward outside of housing.

Properly insert bearing on tool. Using an arbor press only, push tool until tool flange contacts housing. Proceed the same way for both bearings.

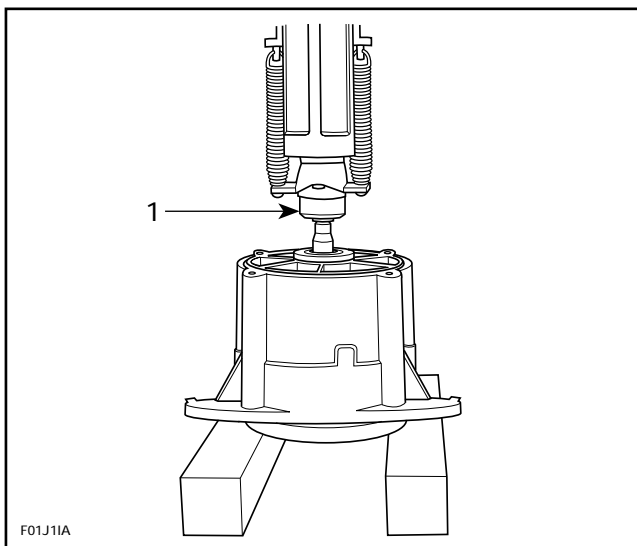


1. Stamped end this side

CAUTION : Never hammer the bearing into its housing.

Section 09 PROPULSION AND DRIVE SYSTEMS

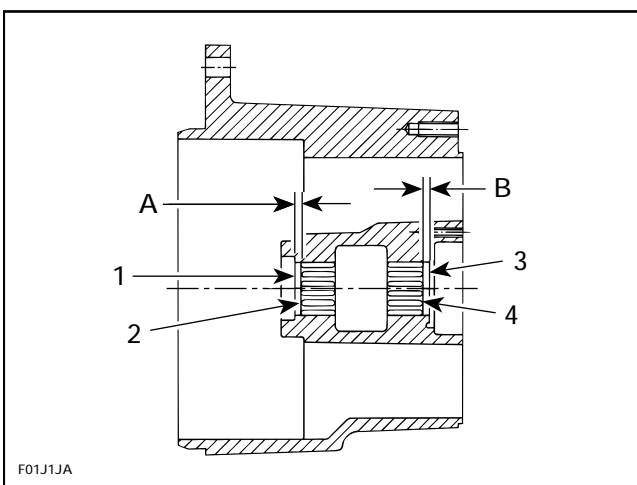
Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)



1. Press on tool until it stops

CAUTION : This tool have been designed to properly position bearings and seal, thus providing space for lubrication purposes. The tool flanges allow this. If a different pusher type is being used, components must be properly positioned as follows.

Bearing on impeller side must be 1.5 to 2.5 mm (.060 - .100 in) inside reservoir measured from seal seat. Bearing on venturi side must be 2 to 3 mm (.080 - .120 in) inside reservoir measured from thrust washer seat. Refer to following illustration.



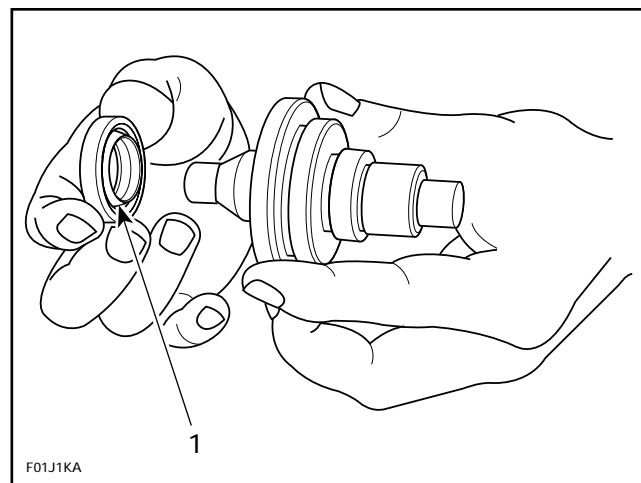
- 1. Seal seat
- 2. Stamped end of bearing
- 3. Thrust washer seat
- 4. Stamped end of bearing
- A. 1.5 - 2.5 mm (.060 - .100 in)
- B. 2 - 3 mm (.080 - .120 in)

Seal must be installed so that lips raised edges are toward outside of housing (toward impeller).

Apply Loctite 515 (P / N 293 800 007) in seal housing, all around outer diameter and on seal seat.

Properly insert seal on tool.

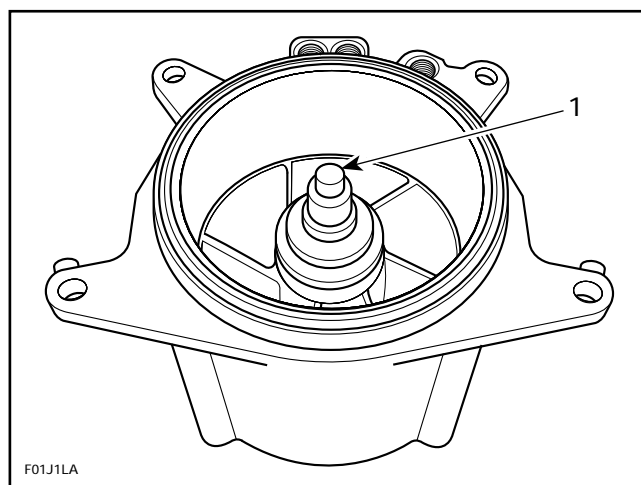
NOTE : Be careful when installing seals to pack seal with grease before inserting bearing / seal installer tool. Properly insert tool in seal with a rotating movement.



1. Raise edge of seal this side

CAUTION : Take care that no sealant contacts any roller of bearing.

Push on tool end with a press until tool flange contacts housing.

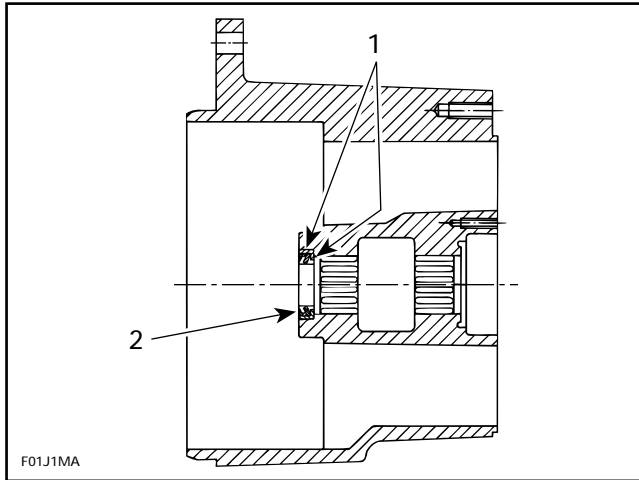


1. Press on tool until it stops

Apply synthetic grease (P / N 293 550 010) between seal lips.

Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)

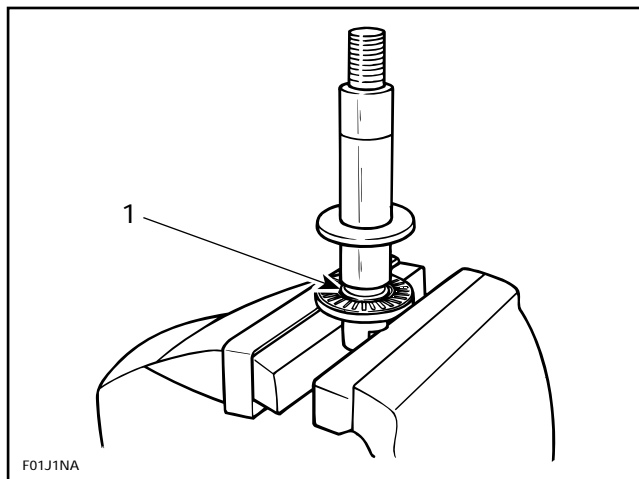


1. Loctite 518 all around and behind
2. Raised edge of seal lip this side

8,19,25,26,27, Impeller Housing, Impeller, Impeller Shaft, Thrust Washer and Thrust Bearing

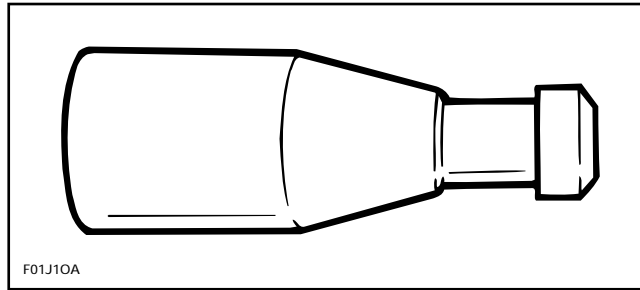
Insert impeller shaft flats in a vise so that shaft is vertical.

Apply synthetic grease (P / N 293 550 010) on both sides of thrust bearing then insert onto shaft followed by thrust washer. Make sure bearing is leaning against shaft flange and washer is properly centered. Grease will prevent parts from sliding at installation and thus possibly wedging thrust bearing into shaft groove.

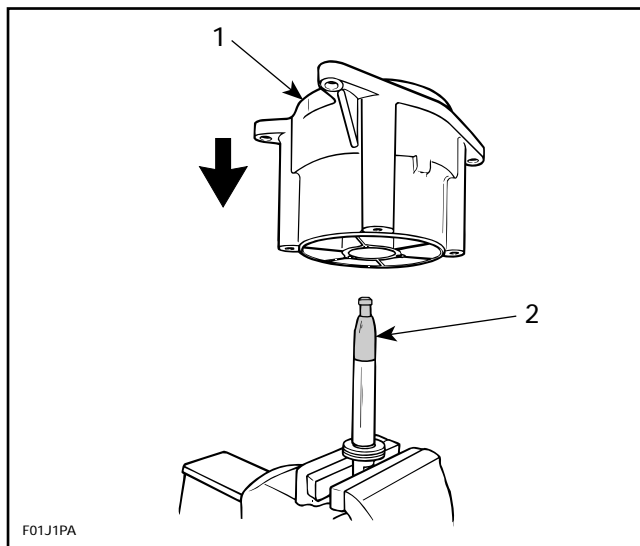


1. Apply oil on faces of parts to prevent them to slide and wedge into shaft groove

To prevent seal lip damage when inserting impeller shaft, use impeller shaft guide (P / N 295 000 002).



Insert tool onto shaft end then carefully slide housing over shaft.



1. Carefully insert housing onto shaft
2. Impeller shaft guide tool

Remove special tool.

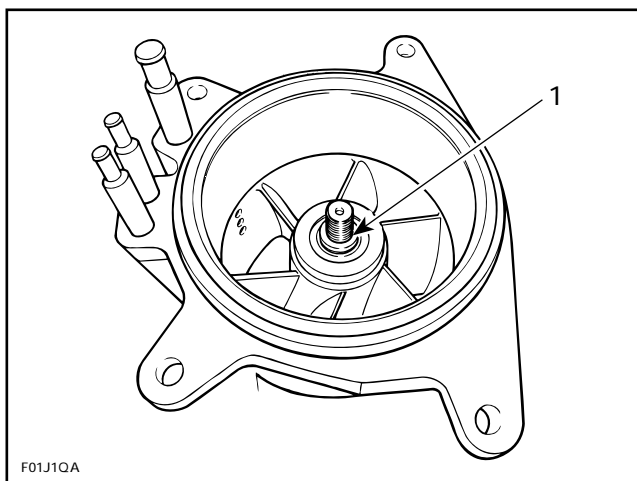
Brush and clean impeller shaft threads and impeller splines with Loctite Safety solvent 755 (P / N 293 800 019) or equivalent. Free threads and splines from any residue. Allow solvent to dry thoroughly.

CAUTION : Be careful not to damage impeller shaft diameter.

Apply Loctite primer N (P / N 293 600 012) on impeller shaft threads. Allow to dry for 2 minutes.

NOTE : Loctite primer is used to reduce Loctite 271 curing time and to activate stainless steel and aluminum surfaces for better bonding action. If applied, complete curing time is 6 hours, if not, 24 hours is needed.

Apply Loctite 271 (red) to shaft threads.



F01J1QA

TYPICAL

1. Apply Loctite 271 (red) on threads

▼ **CAUTION** : Make sure thrust washer and bearing have not slipped in shaft groove.

Using 2 screws previously removed from venturi, secure impeller shaft holder tool to housing. Install shaft holder tool in a vice.

○ **NOTE** : Pump pressurization should be performed at this time. If it leaks, it is easier to determine where. Refer to pump pressurization further in this section.

To ease impeller installation, apply liquid soap on wear ring.

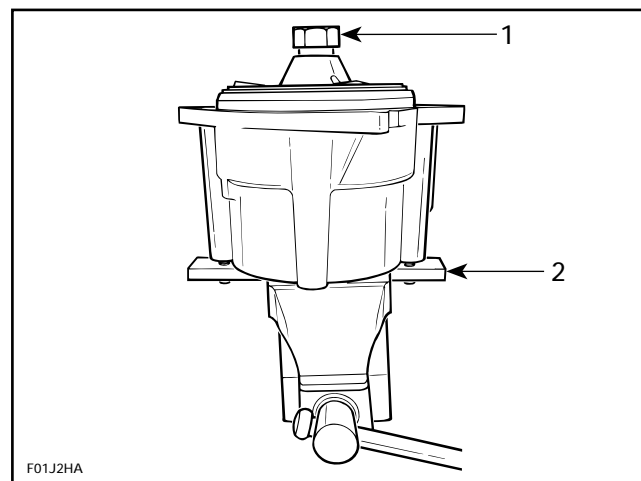
Insert impeller into wear ring. Manually rotate impeller and push so that it slides on impeller shaft threads. Carefully engage threads making sure they are well aligned.

Install impeller remover tool into impeller splines and tighten.

▼ **CAUTION** : Make sure thrust washer and bearing are not wedged in shaft groove. To check, manually pull and push impeller housing, an axial play must be felt.

Torque impeller to 70 N•m (52 lbf•ft) then remove tools.

▼ **CAUTION** : Never use any impact wrench to tighten impeller.

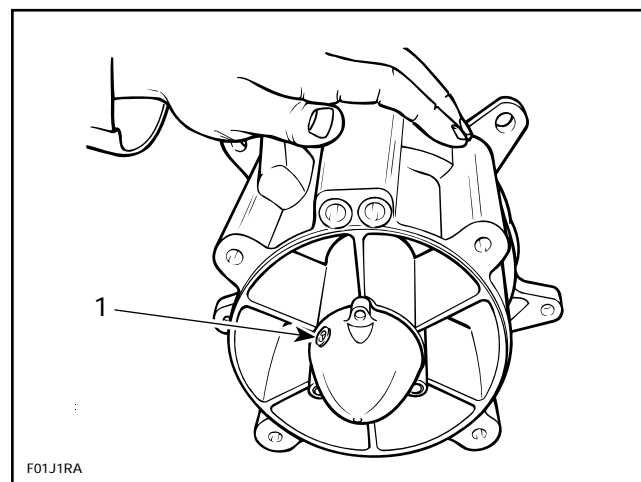


F01J2HA

1. Impeller remover installer tool
2. Impeller shaft holder tool

17,28,29, Housing Cover, O-ring and Loctite 518

Apply Loctite 518 on O-ring and install on housing cover then carefully insert cover on impeller housing making sure to properly position plug on top side.



F01J1RA

1. Filler plug toward top side of pump housing

Apply Loctite 242 (blue) on screw threads and evenly tighten cover screws. Torque to 7 N•m (62 lbf•in).

Section 09 PROPULSION AND DRIVE SYSTEMS

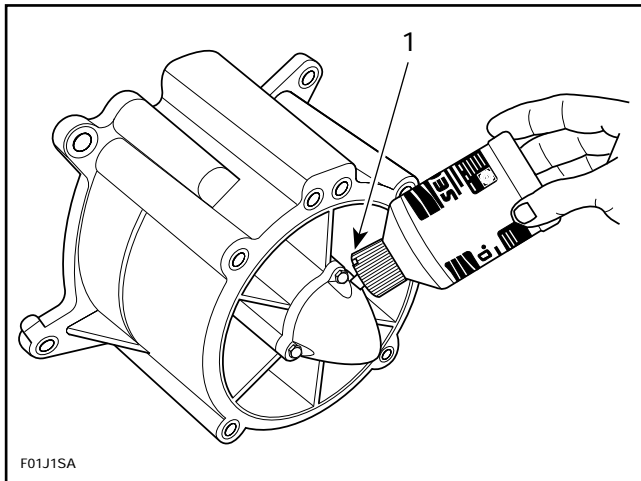
Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)

Oil Fill

Place housing horizontally as in its operating position so that fitting in cover is located in top. Remove fitting from cover. Pour SEA-DOO JET PUMP SYNTHETIC OIL (P / N 293 600 011) in reservoir until oil comes level with bottom of hole. Let oil penetrate in housing and after a few minutes pour oil again until it is level with bottom of hole. Oil capacity is 90 mL (3 oz).

▼ **CAUTION :** This is a synthetic oil. Do not mix with mineral based oil. Do not mix oil brands.

○ **NOTE :** When filling, oil must be poured into cover quite slowly to allow complete housing fill.



1. Pour oil slowly until it flows out of hole

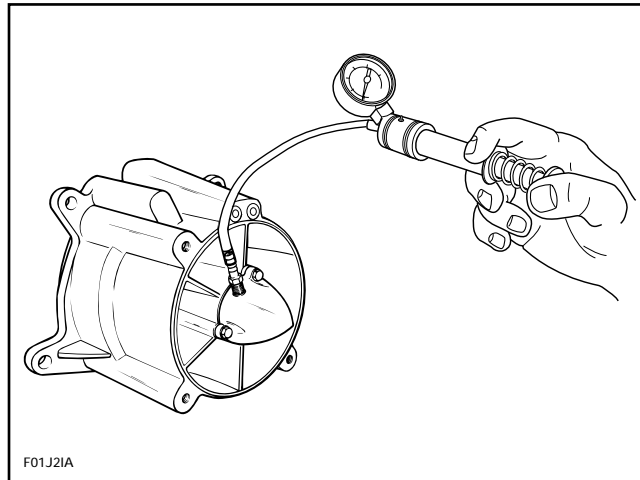
PUMP PRESSURIZATION

Whenever doing any type of repair on the pump, pressure test should be done to check for any leakage.

○ **NOTE :** After complete rebuilding of the jet pump, oil **MUST** be added to the housing **BEFORE** performing the pressure test in order to seat the new seal, otherwise it will leak.

Proceed as follows :

- Apply Loctite PST 592 on threads fitting tool (P / N 295 000 086) then secure on cover.
- Connect pump gauge tester (P / N 295 000 083) to fitting.
- Pressurize pump to a maximum of 70 kPa (10 PSI).



- Pump must maintain this pressure for 10 minutes.

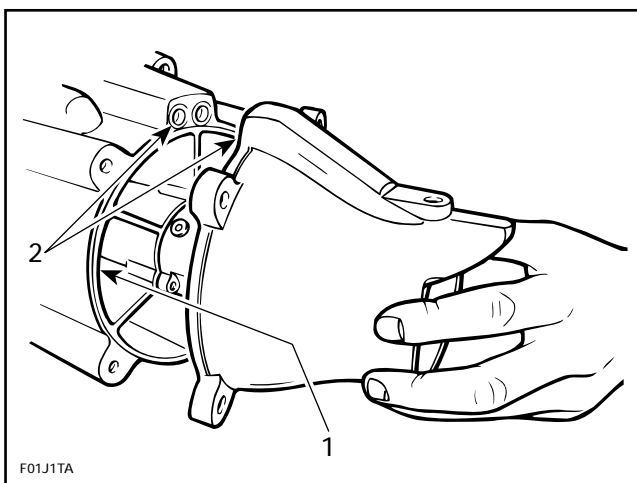
▼ **CAUTION :** Repair any leak, failure to correct a leak will lead to premature wear of pump components.

If there is a pressure drop spray soapy water around housing cover. If there are no bubbles, impeller shaft, impeller shaft seal, or impeller housing is leaking through porosity and has to be replaced. Jet pump unit has to be overhauled.

- Disconnect pump gauge tester and remove fitting.
- Check oil level. Refill as necessary. Apply Loctite PST 592 on plug threads then secure it on cover.

9,10,11, Venturi, Screw and O-ring

Install new O-rings around bailer passages. Position venturi with bailer passages on top. Install reverse gate support. Apply Loctite 518 Gasket Eliminator on mating surface. Apply Loctite 242 (blue) on threads and install screws and washers then torque to 25 N•m (18 lbf•ft) in a criss-cross sequence.



1. Loctite 518 on mating surface
2. Loctite 242 (blue)
3. Bailer passages aligned

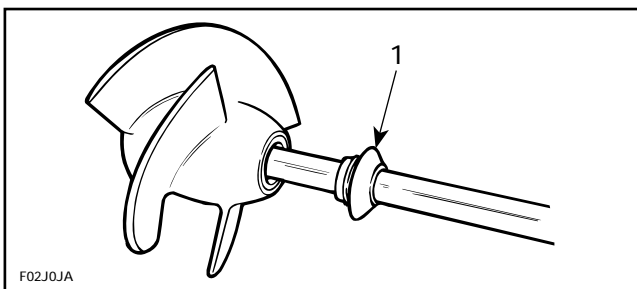
NOTE :Speedster only, on aluminum material it is recommended to use Loctite primer N to reduce curing time and to increase gap filling capability. Refer to manufacturer's instructions.

30, Fitting

Apply Loctite PST 592 on plastic fitting threads. Then thread fitting into pump housing until threads are bottomed.

16, Boot

Slide a new boot and the ring on drive shaft. To ease installation, apply some liquid soap on outer circumference of boot.



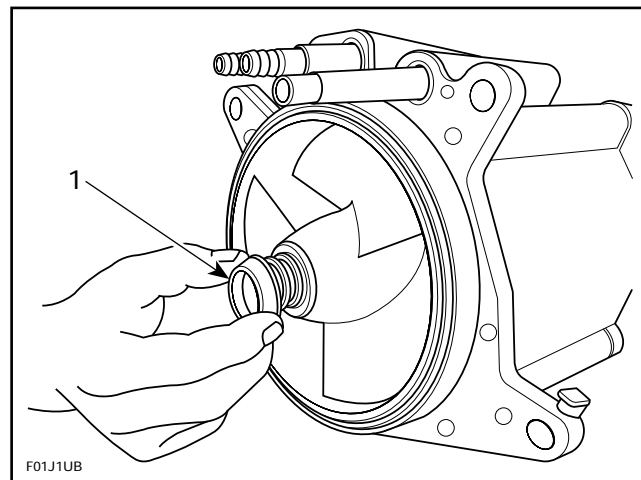
1. Boot

Clean drive shaft splines with Loctite solvent 755. Free splines from any residue. Allow solvent to dry thoroughly.

Generously apply synthetic grease (P / N 293 550 010) on drive shaft splines and impeller splines.

Make sure rubber damper is on drive shaft end.

Insert drive shaft in impeller then carefully insert boot in impeller. Use screwdriver blade to push on boot.



TYPICAL

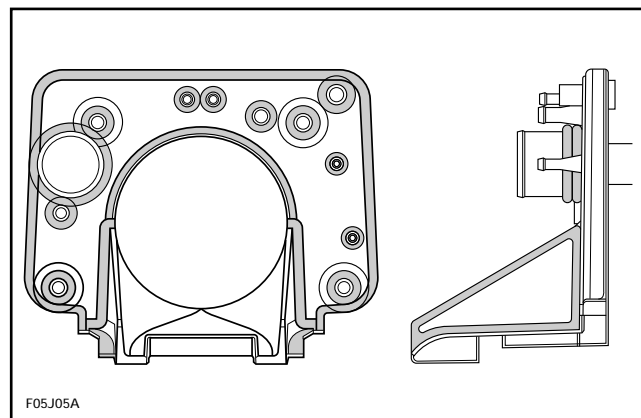
1. Insert boot in impeller

Push ring over boot.

Jet Pump Support

Speedster Only

Apply Ultra Black sealant onto jet pump support as per shaded area in the following illustrations.



TYPICAL

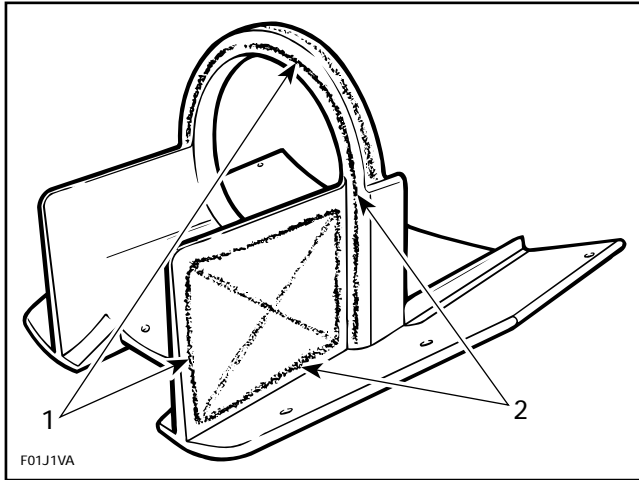
12,13,14,15, Ride Shoe, Screw and Grill

Sportster and Challenger

Apply Loctite 598 Ultra Black on ride shoe as shown in the following illustration.

Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)



TYPICAL

1. Apply Loctite 598 Ultra Black as indicated by shaded area
2. Apply Loctite 598 Ultra Black on left and right ribs

Carefully install ride shoe on hull. Apply Loctite 242 (blue) on screw threads, install and tighten in a criss-cross sequence. Torque to 10 N•m (88 lbf•in).

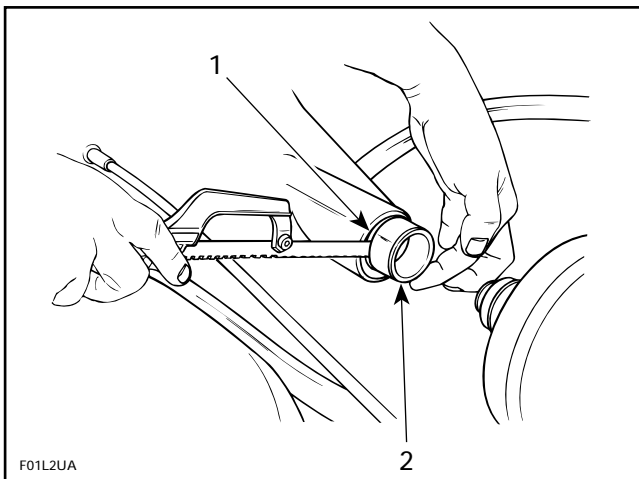
JET PUMP INSTALLATION

32, Hull Insert

Repair

For hull insert repair proceed as follows :

Cut plastic hull insert flush with hull using a saw.

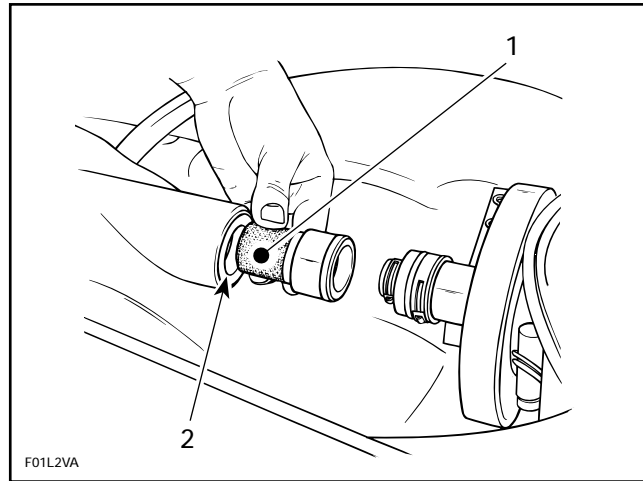


1. Hull
2. Plastic hull insert

Mix epoxy glue (3M-05900), follow manufacturer instructions.

Apply epoxy glue on aluminum insert (P / N 292 000 075) knurled surface and on plastic insert inner bore.

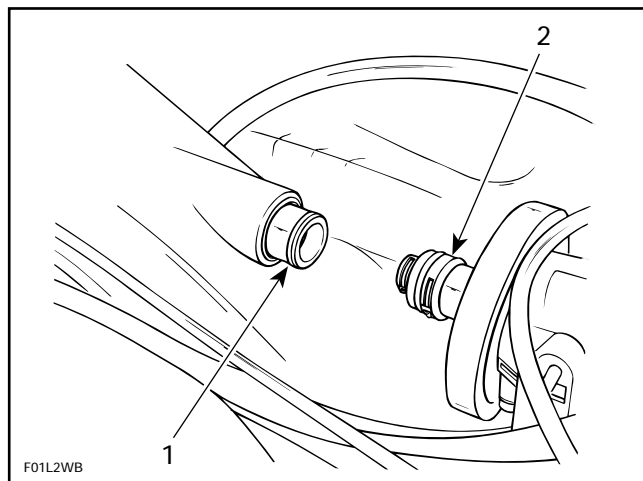
▼ **CAUTION :** A clearance between plastic insert and aluminum insert could possibly be noticed. If so, ensure to fill gap with epoxy glue to obtain aluminum insert adhesion.



1. Knurled surface
2. Inner bore

Install insert into plastic hull insert.

○ **NOTE :** Align aluminum insert as much as possible with PTO flywheel.



1. Aluminum insert
2. PTO flywheel

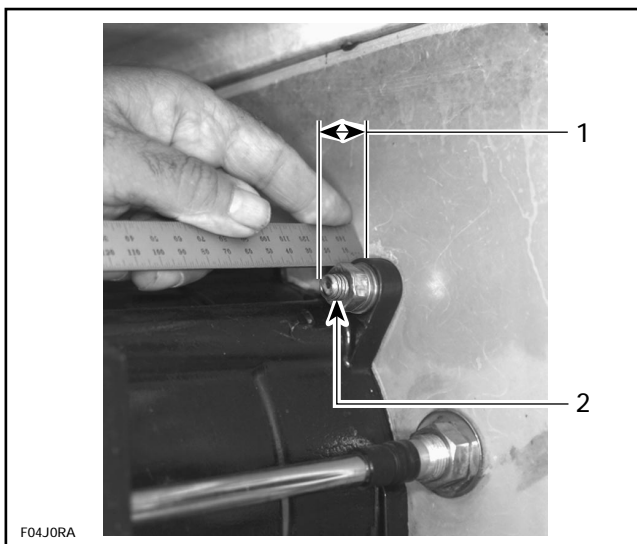
○ **NOTE :** The epoxy glue curing time is 30 minutes.

Jet Pump Pre-installation Check

Check the length of the attachment studs that secure the jet pump to the transom.

Incorrect stud installation may strip the threads in the aluminum anchor plate that retains the stud or the nut may not engage the stud properly.

Check the length of each of the 4 studs protruding from the ride shoe for each of the jet pump housings. Refer the following illustration.



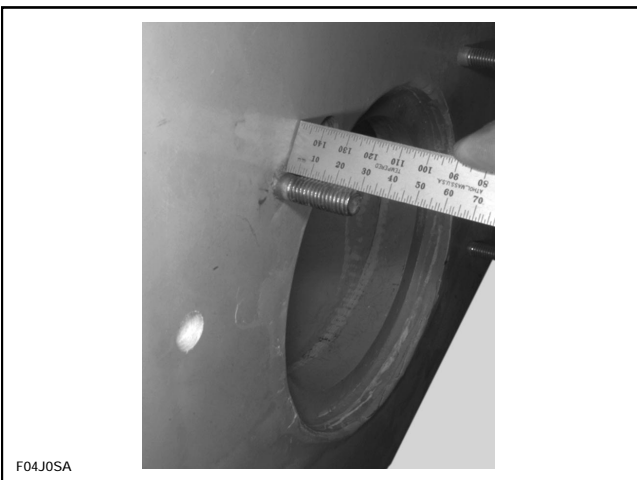
TYPICAL

1. Stud length $30 \text{ mm} \pm 1$ (1.18 in $\pm .04$)
2. 3 threads showing

If the length of any of the studs is incorrect remove studs from transom.

Clean the threads and apply 271 (red) Loctite to the threads of the stud.

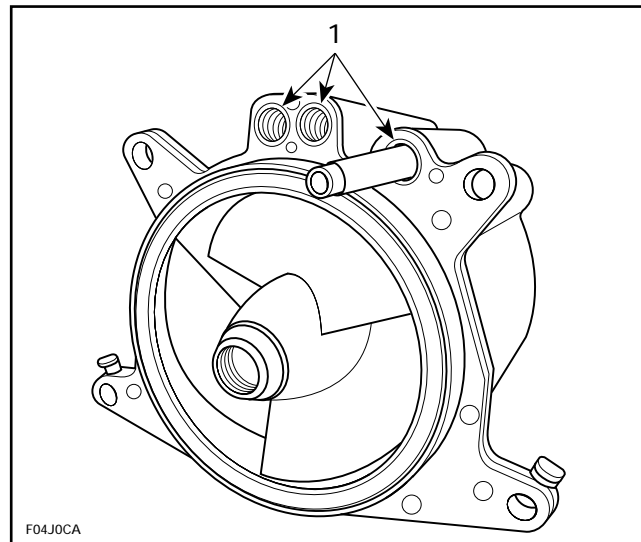
Reinstall, leaving $30 \text{ mm} \pm 1$ (1.18 in $\pm .04$) of the stud extending from the transom surface, refer to the following illustration.



TYPICAL

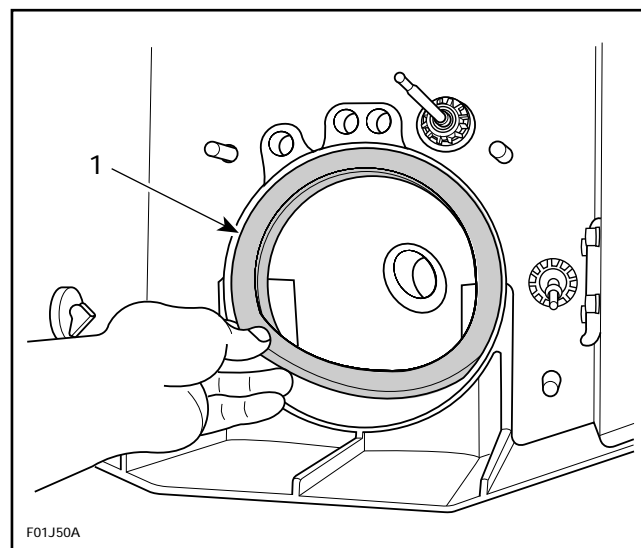
Jet Pump Unit

Apply Loctite 598 Ultra black on pump as shown in the following illustration.



1. Apply Loctite 598 Ultra Black where indicated by dark area

Install a new neoprene seal on ride shoe.



TYPICAL

1. Neoprene seal

Generously apply synthetic grease (P / N 293 550 010) on drive shaft splines and inside O-ring's grooves.

Make sure rubber damper is on drive shaft end.

CAUTION : Some boats have a shim between hull and pump, if shim has been removed ensure to reinstall it. If not install, engine and jet pump alignment will be altered.

Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)

Reinstall drive shaft protector tube and protective boot w / carbon ring.

Install the small O-rings (2) on drive shaft then slide the floating ring over O-rings.

Temporarily install the remaining O-ring on drive shaft end.

Push on pump until shaft comes close to PTO flywheel.

While holding pump, guide and engage shaft splines in PTO flywheel. Rotate shaft to properly index splines. Make sure boot is well positioned over shaft end.

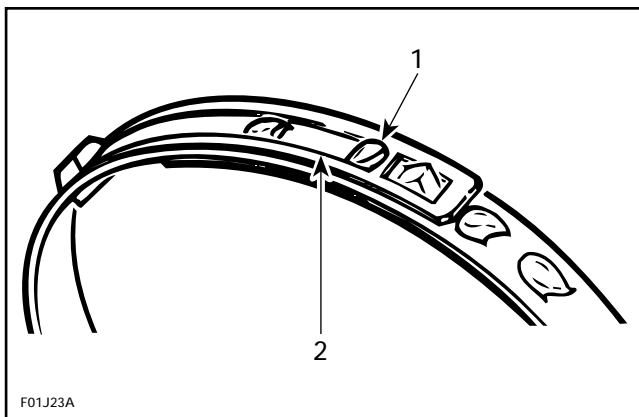
If necessary, tap pump end with a rubber hammer until retaining nuts and washers can be installed. Apply Loctite 242 (blue) on threads and equally tighten nuts in a criss-cross sequence and torque to 35 N•m (26 lbf•ft).

If the stud is properly installed approximately 3 threads will extend beyond the nut. This will allow for full thread engagement of the nut on the stud while maximizing the installed length of the stud in the transom anchor plate.

At PTO flywheel : compress the protective boot, slide floating ring toward the boot and properly install the remaining O-ring in drive shaft groove. Release boot and firmly push floating ring against the O-ring.

Secure PTO flywheel boot clamp as follows :

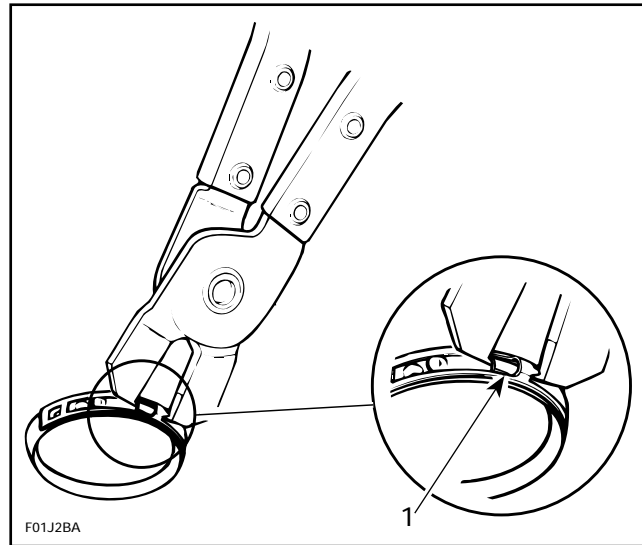
- Use pliers (P / N 295 000 069) as for removal.
- Manually engage holding hook in large window. This is a pre-clamping position only.



PRE-CLAMPING POSITION

1. Holding hook
2. Large window

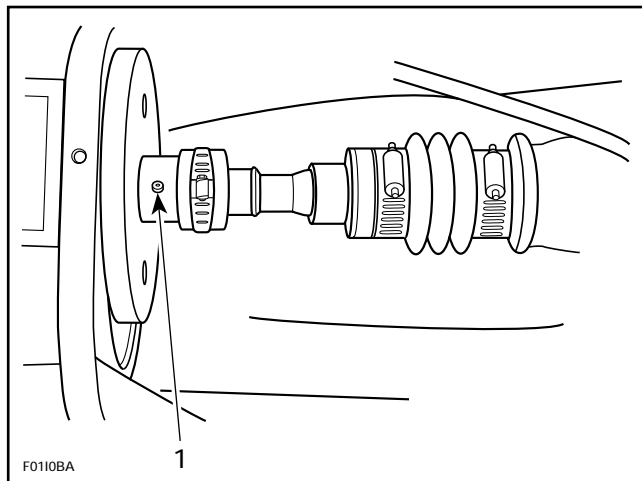
- Insert pointed tips of pliers first in closing hooks.



1. Closing hooks

- Squeeze pliers. When both large and small windows are directly over the 2 locking hooks, press those windows down to engage hooks in windows.

Using a grease gun, carefully lubricate PTO flywheel with synthetic grease (P / N 293 550 010), until boot is just beginning to expand. From this point, immediately stop.



1. Grease PTO flywheel

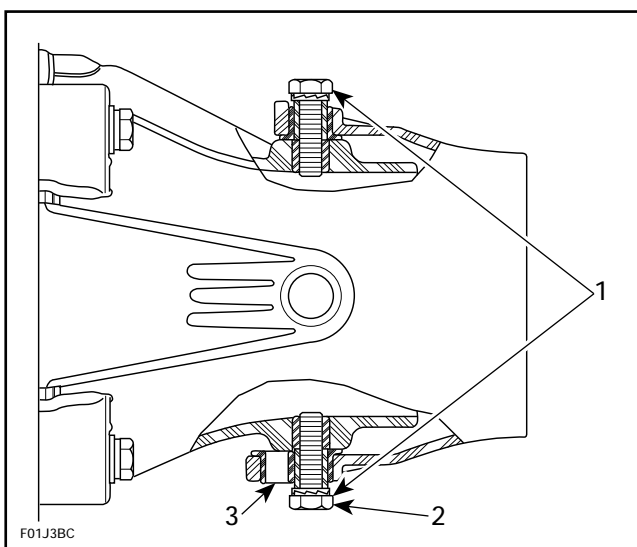
Secure flywheel guard to engine studs with washers and wing nuts.

Secure coolant inlet to impeller housing using tie raps.

1,2,3,4,5, Screw, Sleeve, Bushing and Nozzle

Insert bushings in nozzle, positioning their flanges from inside of nozzle. Apply BOMBARDIER LUBE lubricant (P / N 293 600 006) on outer circumference of sleeve then insert in nylon bushings.

Install nozzle on venturi, position its steering arm on RH side. Apply Loctite 242 (blue) on threads. Install screws position bottom screw in one of the holes then torque to 20 N•m (15 lbf•ft). The holes give a trim adjustment (not applicable to Challenger and Sportster).



TYPICAL

1. Torque to 20 N•m (15 lbf•ft)
2. 5° raise front and give a little more speed
3. 0° factory position

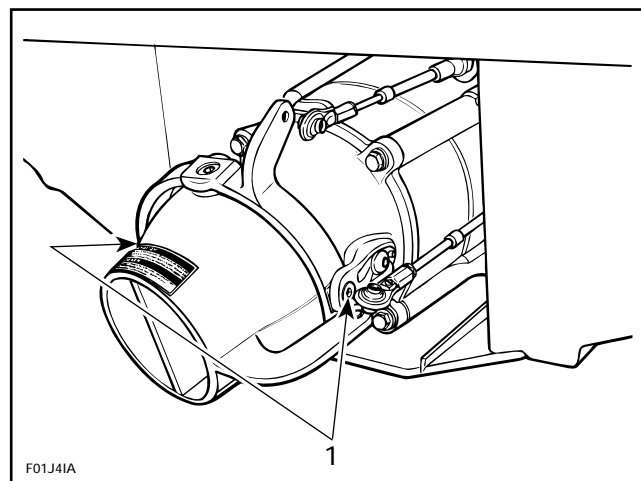
◆ **WARNING :** Loctite must be applied on screw threads and screw must be torqued as specified.

Challenger

Install nozzle / trim ring assembly.

Torque screws to 14 N•m (10 lbf•ft).

○ **NOTE :** Trim ring has a tight fit ; to install, insert both sides at the same time, taking care not to break plastic bushings. Carefully use a plastic tip hammer if necessary. Make sure steering arm of jet pump is on right side and trim arm is above venturi housing.

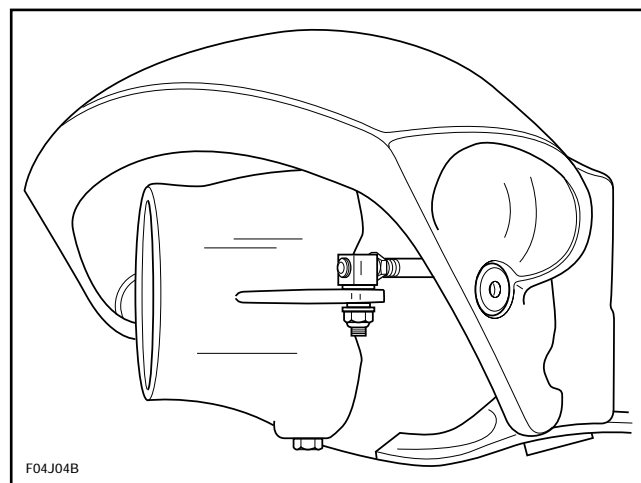


TYPICAL

1. Torque screws to 14 N•m (10 lbf•ft)

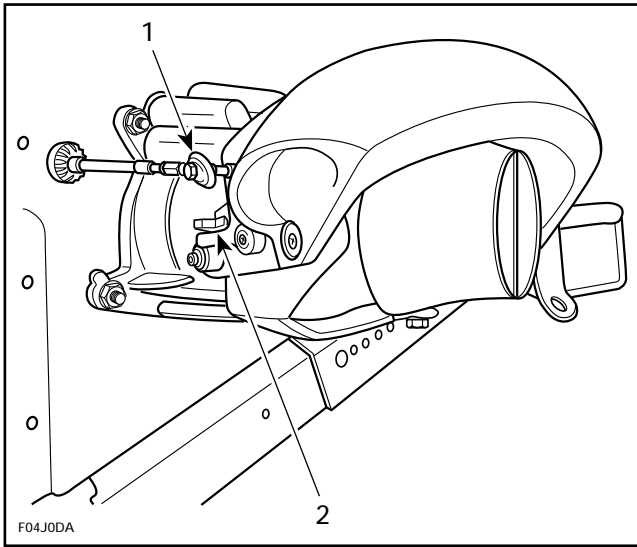
All Models

Reinstall adjuster of steering cable and ball joint of reverse cable. Torque bolts to 7 N•m (63 lbf•in).



Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 01 (PROPULSION AND DRIVE SYSTEMS)



1. Ball joint parallel with cable lever
2. Latching mechanism

NOTE :Ball joint must be parallel with cable lever. If not, slacken jam nut and adjust ball joint. Torque jam nut to 2.5 N•m (23 lbf•in).

Check steering alignment. Refer to STEERING SYSTEM 10-02 then refer to adjustment.

Proper install VTS cable (Challenger). For adjustments, refer to VARIABLE TRIM SYSTEM 09-03.

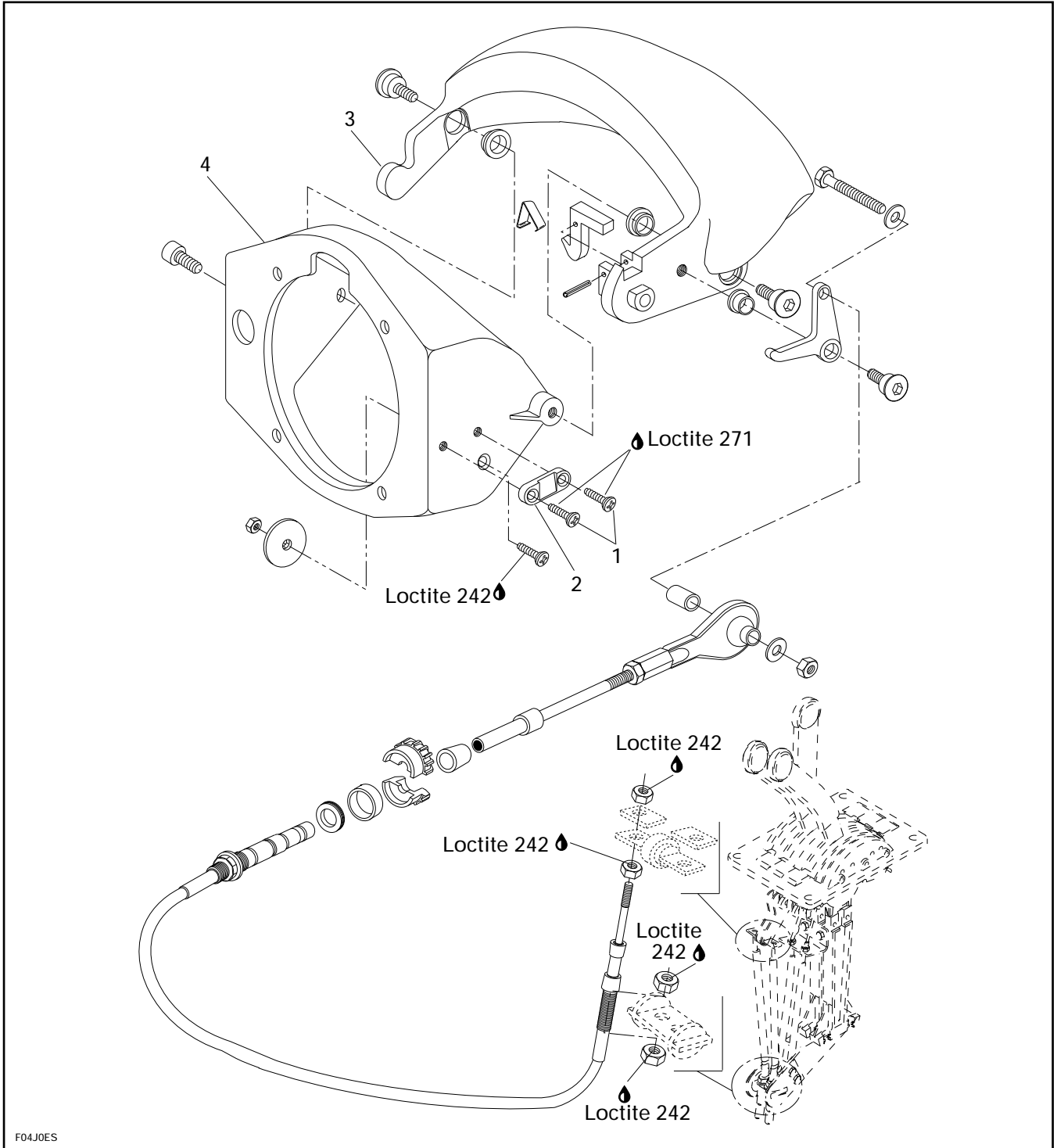
Slightly lubricate wear ring with a soapy solution before starting to minimize friction during initial start.

To allow impeller adjustment into wear ring, start engine to let impeller rotate for a few seconds.

CAUTION : Water must be supplied to cool engine with a garden hose.

REVERSE SYSTEM

All Models



Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 02 (REVERSE SYSTEM)

DISASSEMBLY

Pay attention to the following :

1,2, Screw and Stopper

Prior to slacken screws, heat to break the Loctite bond.

4, Reverse Gate Support

- Detach steering / shifter cables
- Remove nozzle
- Remove reverse gate support

INSPECTION

Check all moving parts and bushings for wear, straightness, corrosion and free movement. Replace parts as required.

Check sacrificial zinc anode for oxydation and replace if required.

ASSEMBLY

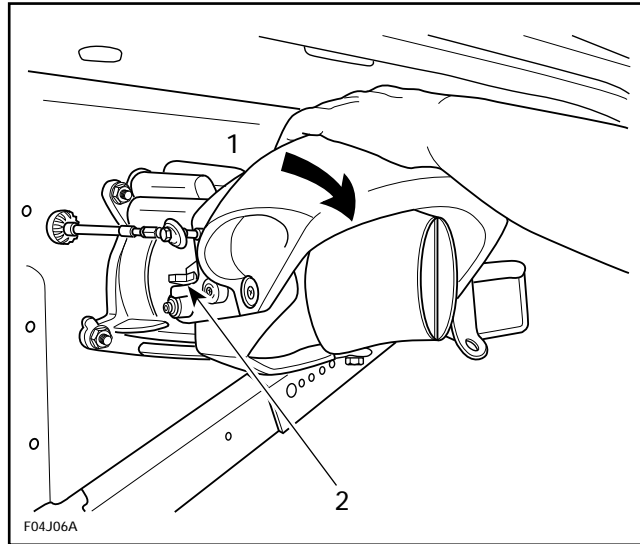
Prior to assemble moving parts, lubricate with synthetic grease.

Reinstall steering and shifter cables. For steering **alignment**, refer to STEERING SYSTEM 10-2 then look for alignment. Ensure that steering cable ball joint is parallel with cable lever.

Reverse Gate Locking System Verification and Adjustment

Fully pull throttle lever(s) to idle position then pull shifter in reverse position. Ensure reverse gate ear contacts the stopper.

Fully push shifter in forward position. A latching sound should be heard. Try manually pulling reverse gate(s) down. They must be locked by the latching mechanism.



IN FORWARD POSITION

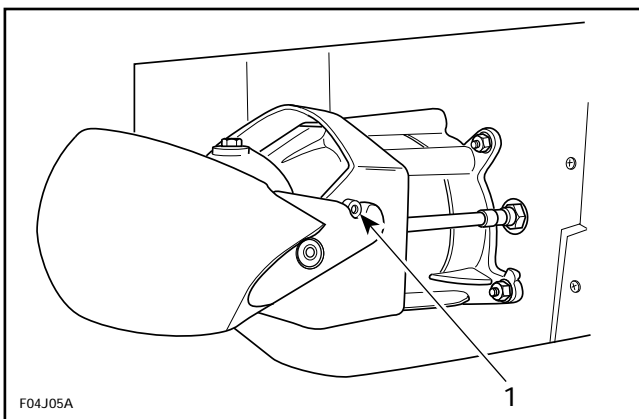
1. Must be locked when manually pulling downward
1. Latching mechanism

If either check fail, readjust cable to meet both conditions.

Shifter Cable Adjustment

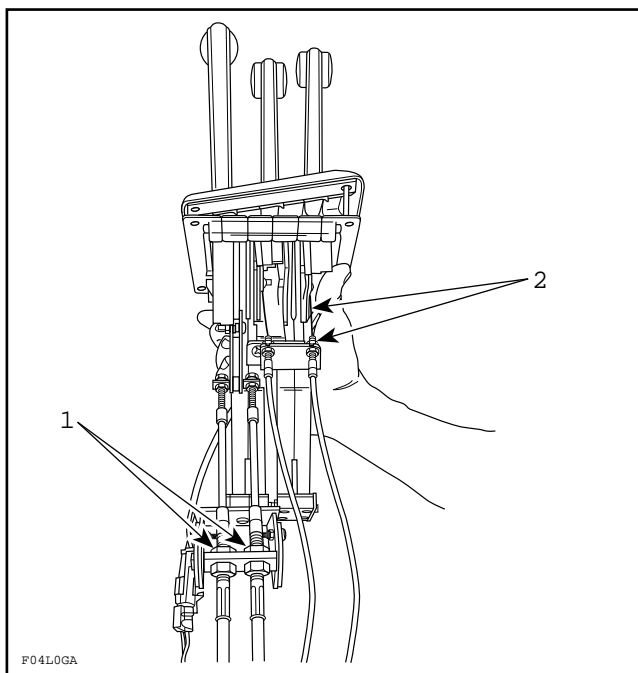
Unscrew throttle / shifter control from boat.

▼ **CAUTION :** Use a protective mat (P / N 295 000 129) in shifter area when withdrawing it for adjustment.



IN REVERSE POSITION

1. Must touch



TYPICAL - SPEEDSTER MODEL SHOWN

1. Adjust reverse gates individually here

Shifter Cable Replacement

Detach cable ball joint from cable lever on reverse gate then unscrew ball joint from cable.

From inside of hull, slacken lock nut. From outside of hull, pull cable to allow half rings removal.

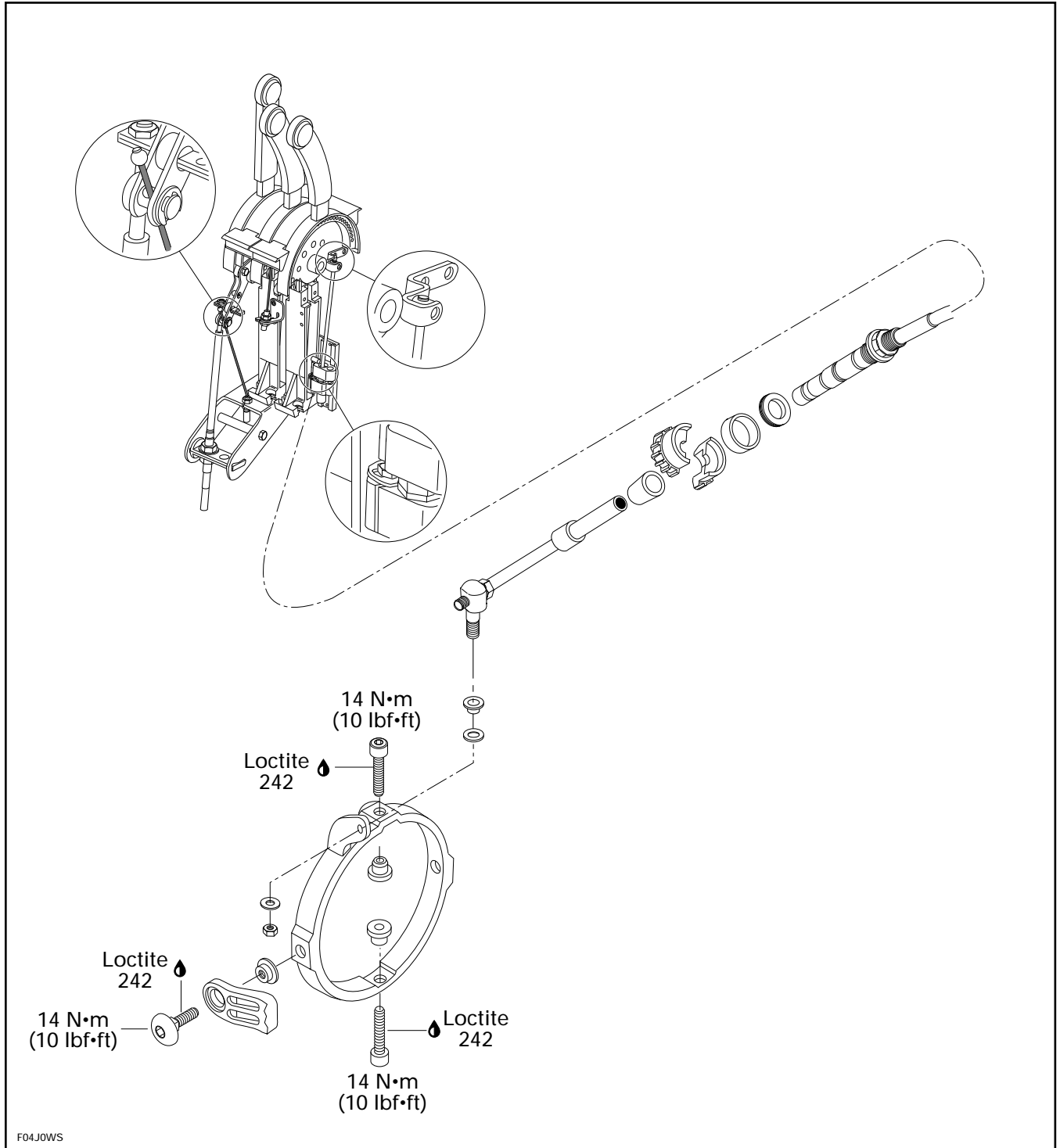
For the other end of cable, remove throttle shifter control from boat and detach cable from mechanism.

At assembly, ensure to properly tighten lock nut. Check watertightness.

Adjust as explained above.

VARIABLE TRIM SYSTEM (VTS)

Challenger



Section 09 PROPULSION AND DRIVE SYSTEMS

Sub-Section 03 (VARIABLE TRIM SYSTEM (VTS))

Trim Cable Replacement

Detach cable adjuster from trim ring then unscrew adjuster from cable end.

From inside of hull, slacken lock nut. From outside of hull, pull cable to allow half rings removal.

For the other end of cable, remove the controller from the deck and detach cable from its mechanism.

At assembly, ensure to properly tighten lock nut. Check watertightness.

Adjust as explained below.

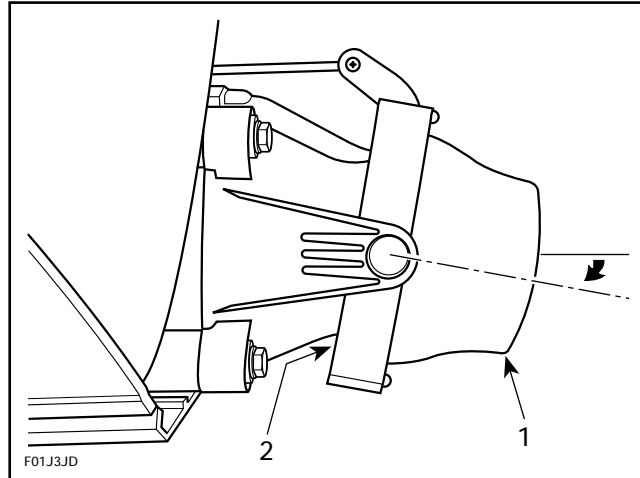
ADJUSTMENTS

Cable Adjustment

Set the shifter to FORWARD.

Completely move the VTS lever in one direction and ensure the trim ring and / or nozzle is not interfering with the venturi housing. Check in both directions. If adjustment is required, it can be done at the jet pump unit. Turn adjuster as required. Ensure the cable end remains protruding the adjuster.

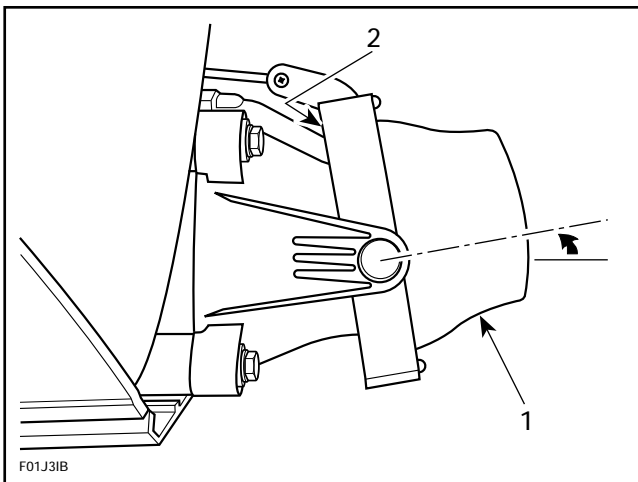
▼ **CAUTION** : Trim ring and / or nozzle must not interfere with venturi. Damage to cables and /or venturi housing may occur if adjustment is not done adequately. After adjustment, ensure the cable end remains protruding the adjuster at the jet pump.



TYPICAL

1. Nozzle down
2. No interference

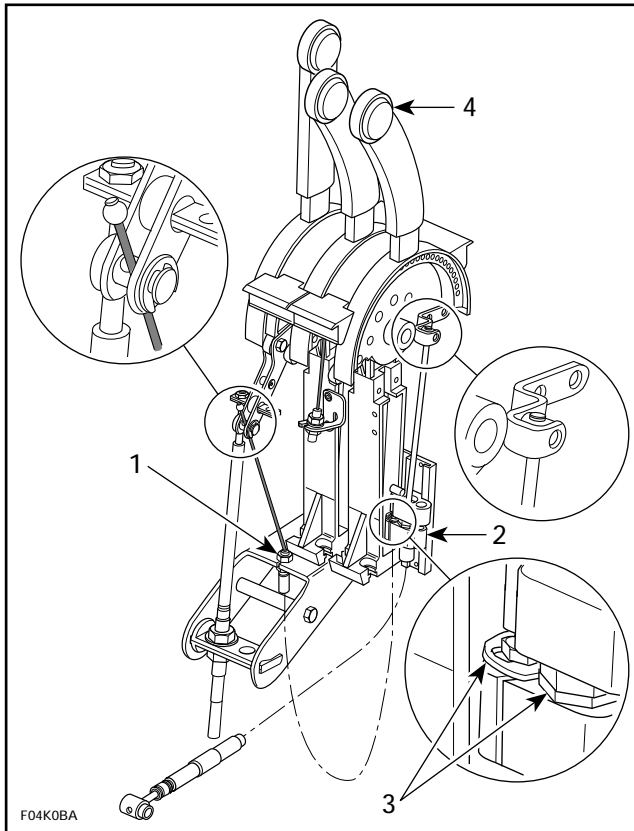
If not enough adjustment is available at the nozzle, detach the controller from the deck and check the VTS auto-centering adjustment. While the shifter is in the FORWARD position, the slider blocks must hold together with a tension in their cable. Adjust as necessary as show in illustration.



TYPICAL

1. Nozzle up
2. No interference

Section 09 PROPULSION AND DRIVE SYSTEMS
Sub-Section 03 (VARIABLE TRIM SYSTEM (VTS))



TYPICAL

1. Adjust slider mechanism cable here while shifter is at FORWARD
2. Adjust cable so that blocks hold together with a tension in the cable
3. Ensure cable locking devices are properly installed
4. VTS lever

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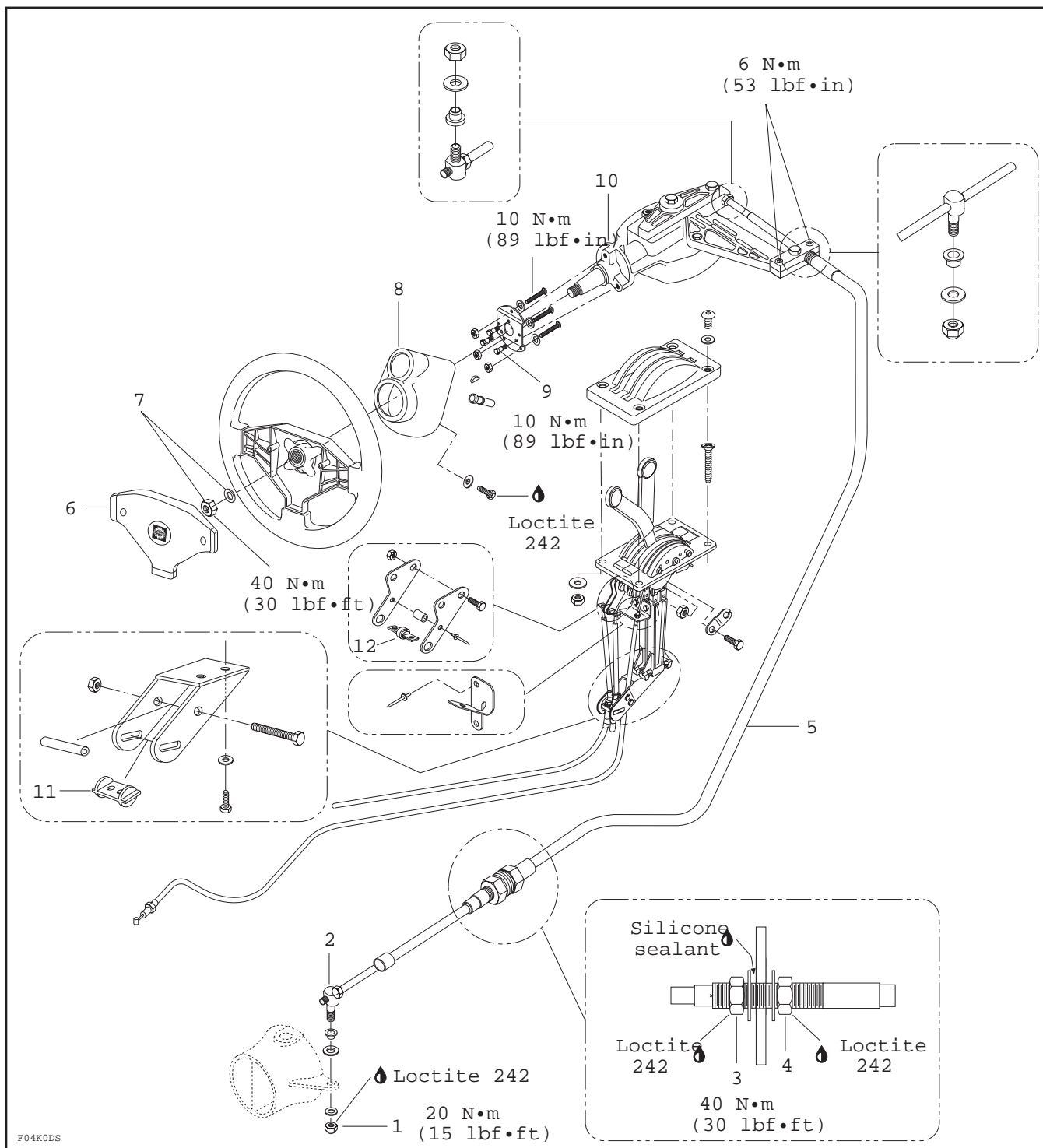
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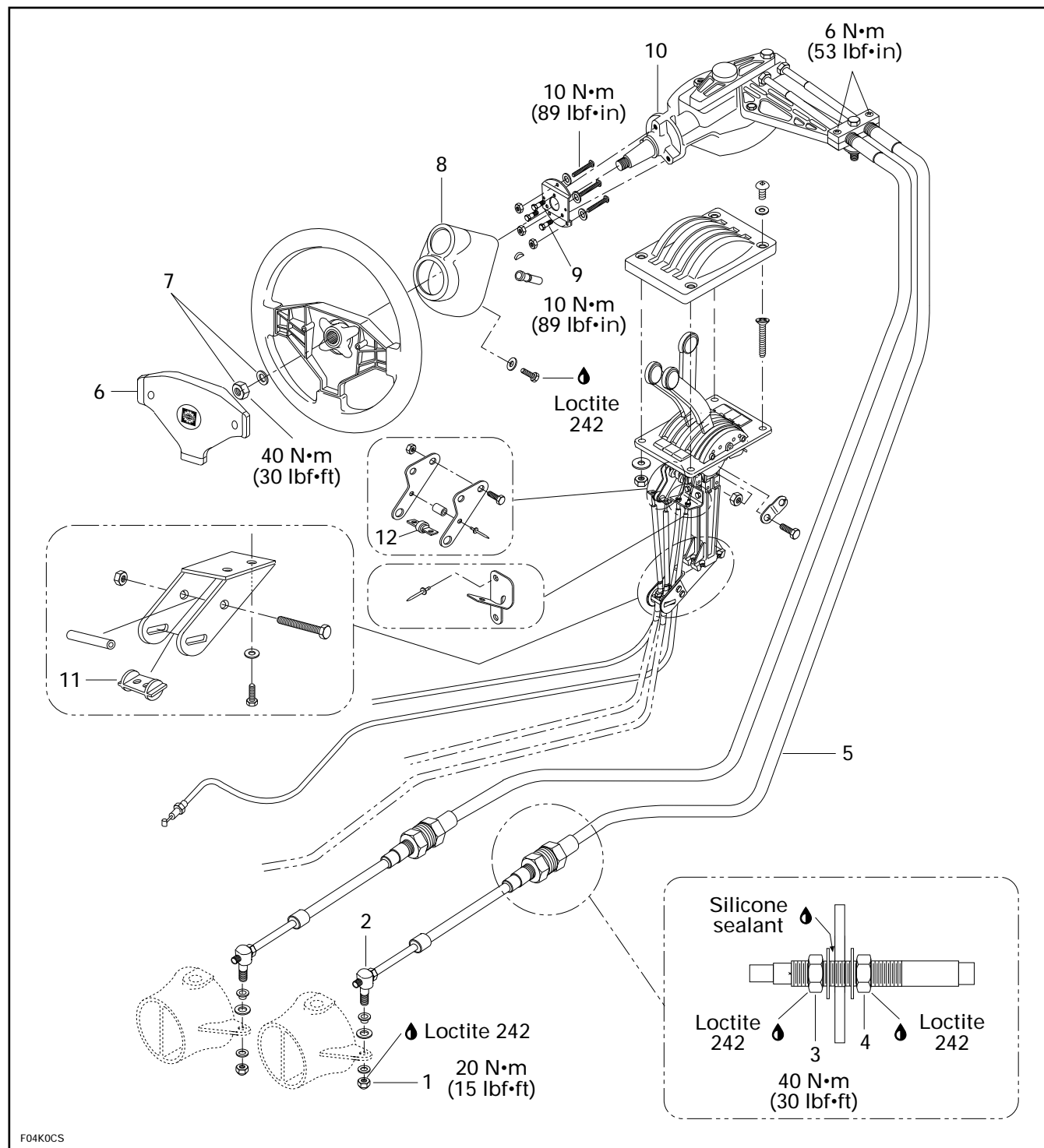
STEERING SYSTEM

Sportster



Section 10 STEERING SYSTEM
Sub-Section 01 (STEERING SYSTEM)

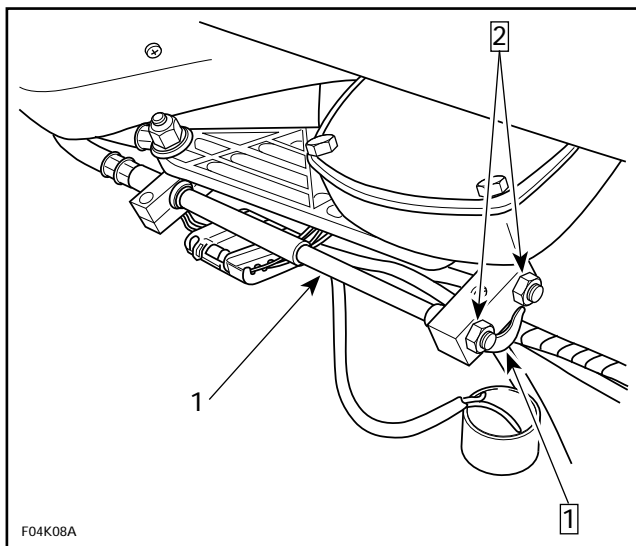
Speedster



STEERING SYSTEM INSPECTION

Check operation of steering. It must turn easily and smoothly with a regular resistance from side to side. Rotating resistance must be at a minimum. No friction should be felt. No frictional sound should be heard. Check steering end play. If something is wrong, isolate cable(s) from steering helm to diagnose faulty part. Proceed as follows :

- Visually check cable(s) for wear and oxidation at steering helm and at nozzle. Check at end of cable housing(s). Replace as necessary.
- Detach cable end from helm arm. **On Speedster model**, separate cables from each other.



SPEEDSTER SHOWN

Step ① : Detach from helm arm

Step ② : Separate cables

1. Check for wear (particularly brass bushing wear) or oxidation in this area

- Check cable movement (individually on **Speedster**). Replace as necessary.

○ **NOTE : Speedster only**, if one cable is damaged, it is likely that the other one will be too.

Turn steering from side to side, if rotation movement is abnormal or if end play is excessive, replace steering helm as an assembly.

◆ **WARNING : Disassembly of the steering helm can lead to steering failure. Replace complete assembly. For cable assembly, use supplied hardware only. Do not use substitutes.**

STEERING CABLE REPLACEMENT

Removal

- Remove nut **no. 1** from adjuster **no. 2**, then from nozzle.
- Remove nut **no. 3** from cable.
- From inside of hull, remove silicone around lock nut **no. 4** of cable.
- Pull cable out of transom.
- Detach cable end from helm arm.
- Detach cable housing from helm.
- Remove cable from hull.

Installation

Reinstall removed parts and pay attention to the following :

- Pass cable through transom.
- Screw external nut **no. 3** and keep 1-2 threads protruding out of nut.
- Tighten internal nut **no. 4**.
- Position adjuster half way on threaded length of cable end.
- Secure adjuster on nozzle.
- Secure cable housing to helm then cable end to helm arm.
- Proceed with steering adjustment. Refer to ALIGNMENT, section 10-02.
- From inside of hull, apply sealant adhesive (P / N 293 800 033) on cable and nut area to seal hull.
- Check cable / hull watertightness.

STEERING HELM REPLACEMENT

Removal

- Remove steering cover **no. 6** by removing caps and screws.
- Remove lock nut **no. 7** and withdraw steering. Be careful to keep Woodruff key for reinstallation.
- Remove steering collar **no. 8**.
- Disconnect steering cable(s) as described before.
- Remove screws **no. 9** and withdraw steering helm **no. 10**.

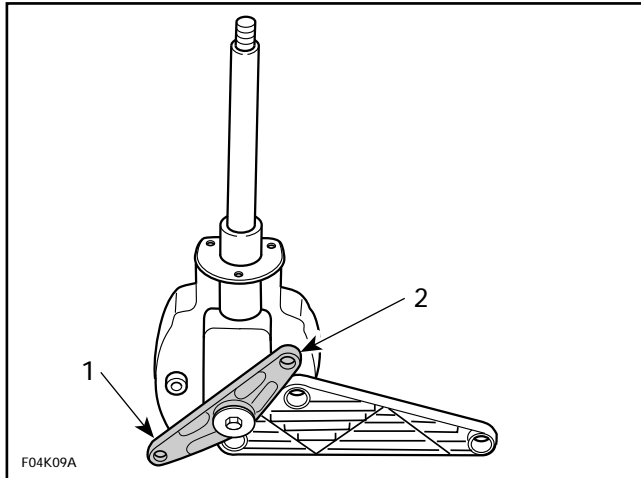
Section 10 STEERING SYSTEM

Sub-Section 01 (STEERING SYSTEM)

Installation

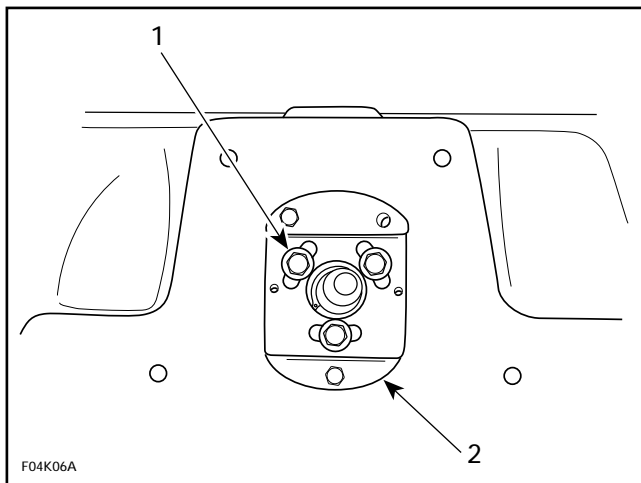
Reinstall removed parts and pay attention to the following :

Prior to installing steering helm to boat, position helm arm as shown.



1. Correct position
2. Helm arm

- When installing steering helm to boat, position screws no. 9 as required in slots on mounting plate to keep space between helm / cable and body. Centering screws in slots is a good starting point.

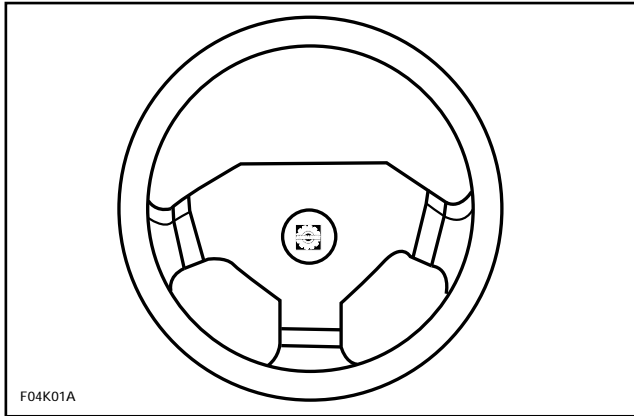


1. Screw centered in slot
2. Mounting plate

- Torque screws as indicated in exploded view.
- Ensure to install Woodruff key.
- Torque lock nut of steering as indicated in exploded view.
- Proceed with steering alignment. Refer to ALIGNMENT, section 10-02.

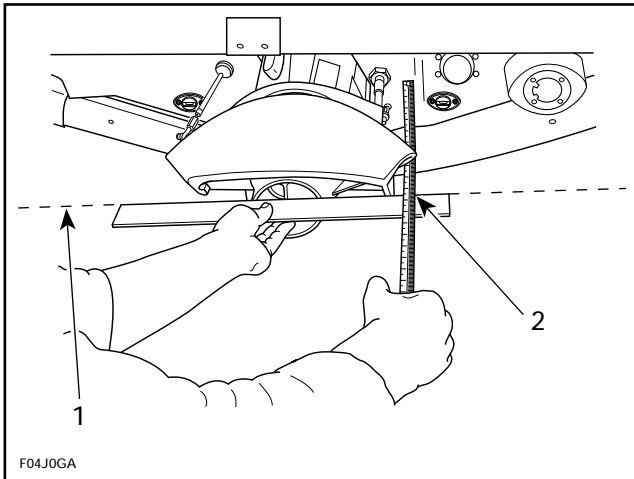
ALIGNMENT

Position steering in straight ahead position.



Sportster and Challenger Models

Check jet pump nozzle alignment and steering centering by placing a straight edge on nozzle end. Straight edge must be parallel with transom.

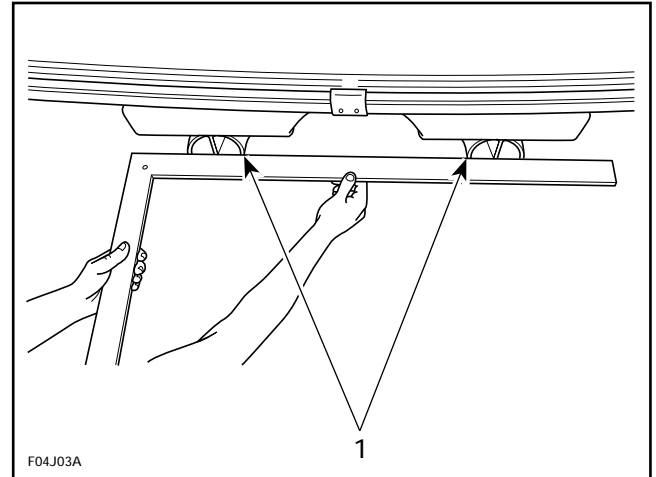


TYPICAL

1. Parallel with transom
2. Measure distance between transom and straight edge

Speedster Model

Check jet pump nozzle alignment / synchronization by placing a straight edge across both nozzle ends.

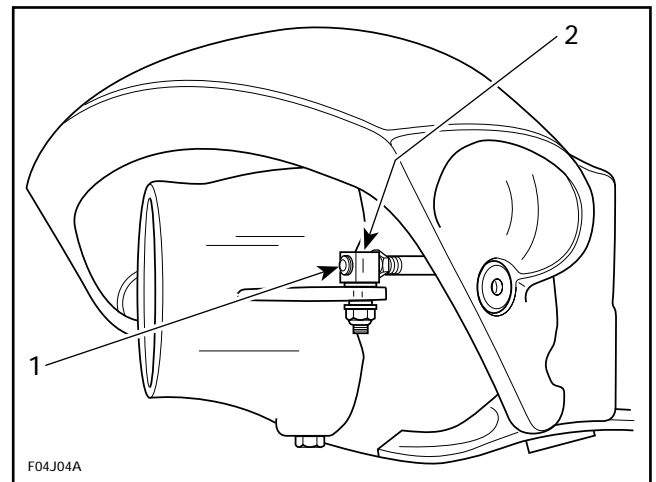


1. Straight edge across nozzle ends

All Models

A small adjustment can be made with adjuster on nozzle. On Speedster, any nozzle can be adjusted.

▼ **CAUTION :** Cable end must remain protruding adjuster.



TYPICAL

1. Cable end must protrude here
2. Adjuster

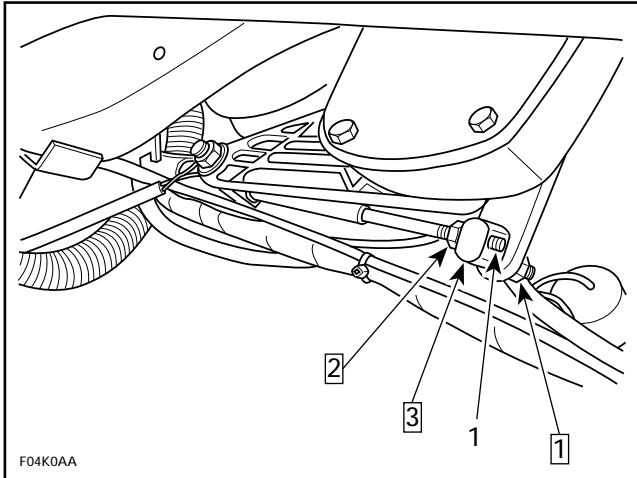
If not enough adjustment is available here, adjust cable end on steering helm arm.

▼ **CAUTION :** Cable end must remain protruding helm mounting block.

Section 10 STEERING SYSTEM

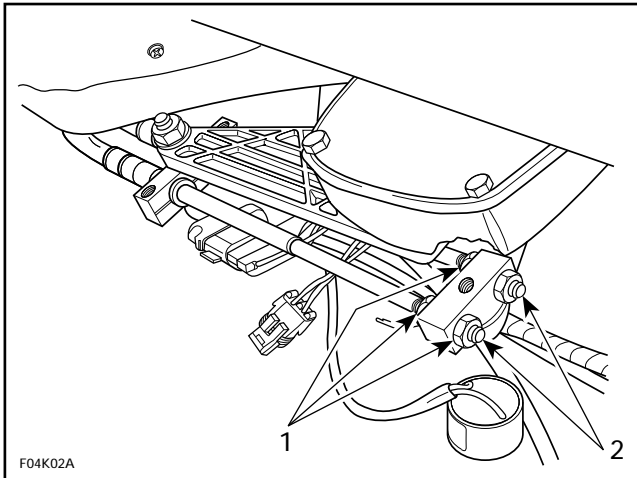
Sub-Section 02 (ALIGNMENT)

Sporster and Challenger Models



- Step 1 : Remove nut
Step 2 : Slacken lock nuts
Step 3 : Turn to adjust
1. Cable end must protrude here

Speedster model



1. Adjust here
2. Cable end must protrude here

Ensure to apply Loctite on parts as indicated on exploded view.

THROTTLE / SHIFTER / VTS CONTROLLER

REMOVAL

Unscrew retaining screws.

▼ **CAUTION** : Use a protective mat (P / N 295 000 129) in shifter area when withdrawing controller.

INSPECTION

Check all moving parts for free movement and for excessive play. Pay attention to pivot plate nos. 11-12 and the VTS slider mechanism.

Check cables for wear and oxidation.

Replace parts as required.

LUBRICATION

Lubricate moving parts with synthetic grease. Where not possible, apply BOMBARDIER LUBE. Spray BOMBARDIER LUBE on cable of the VTS slider mechanism.

ADJUSTMENTS

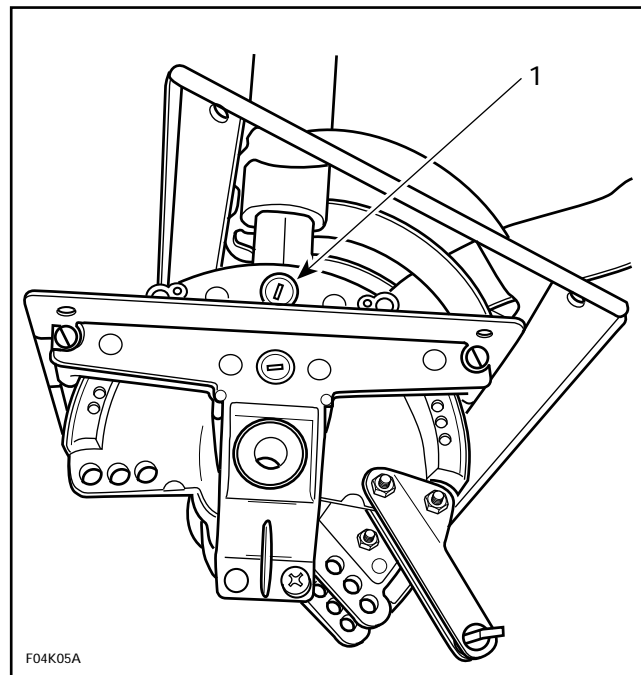
Throttle, shifter and VTS cable adjustment are covered in FUEL SYSTEM, **Carburetors** section 06-03, PROPULSION AND DRIVE SYSTEM, **Reverse System** section 09-02 and **Variable Trim System** section 09-03 respectively.

Lever Friction Adjustment

Lever friction can be adjusted to suit operator's preferences. Throttle lever friction can be synchronized on **speedster model**.

Turn set screw clockwise to increase friction and counterclockwise to decrease it.

Sportster



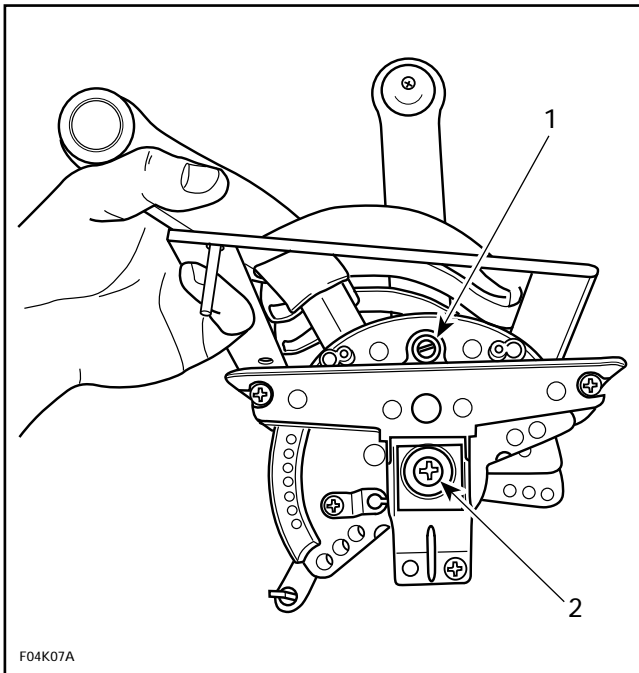
1. Set screw (1 screw each side for each lever)

To adjust shifter friction, turn set screw that is on the same side as shifter lever. For throttle, turn set screw on the same side as its lever.

Section 10 STEERING SYSTEM

Sub-Section 03 (THROTTLE / SHIFTER / VTS CONTROLLER)

Speedster



1. Set screw of shifter and starboard throttle (outer lever)
2. Set screw of port throttle (inner lever)

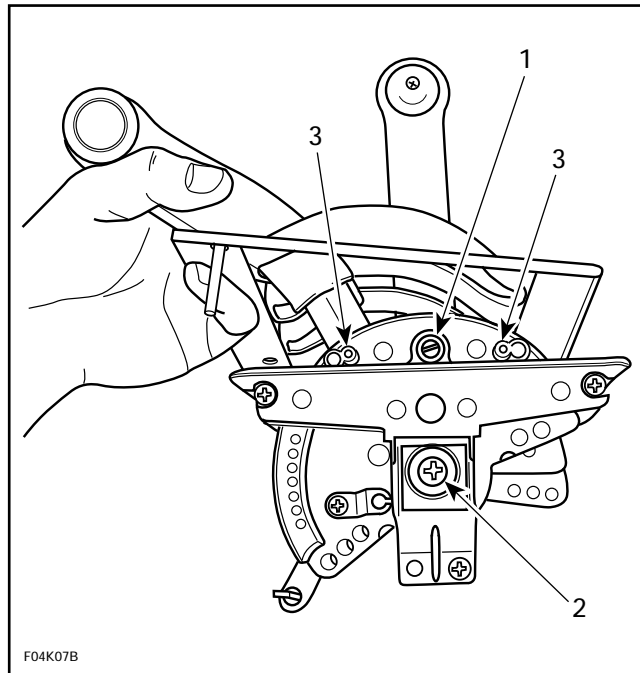
To adjust shifter friction, turn set screw that is on the same side as shifter lever.

To adjust starboard throttle lever (outer lever), turn set screw on the same side as its lever.

To adjust port throttle lever (inner lever), turn set screw on center of pivot point of lever.

Ensure that both throttle levers have the same friction.

Challenger



TYPICAL

1. Set screw of shifter and VTS
2. Set screw of throttle
3. Screws and springs for "ratchetting" effect of the VTS lever

To adjust shifter friction, turn set screw that is on the same side as shifter lever.

The set screw of the VTS lever has very little effect because of the "ratchetting" mechanism.

To adjust throttle lever turn set screw on center of pivot point of lever.

The "ratchetting" effect for the VTS lever is provided by 2 spring-loaded steel balls (see illustration). If the "ratchetting" is not felt, check those components.

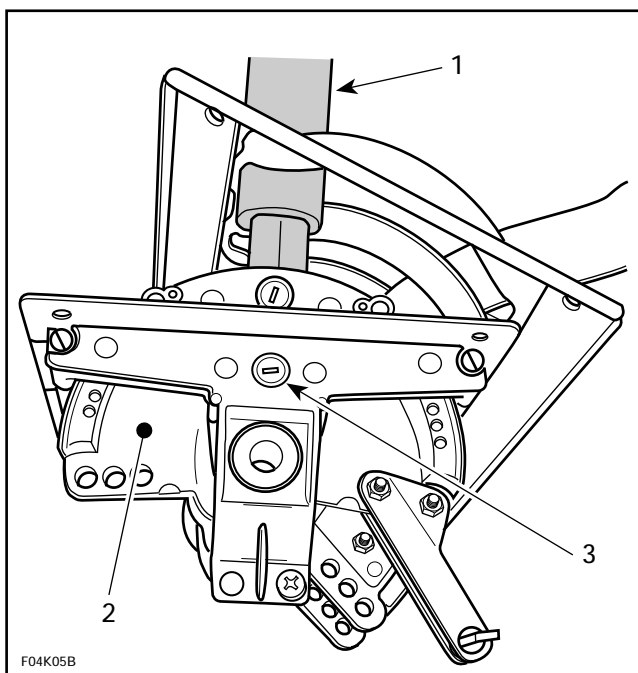
Shifter Lock Adjustment

All Models

The locking action can be adjusted. The positions Forward / Neutral / Reverse are "notched" by means of a steel ball pushed by a spring against a notch on shifter plate.

Turning the set screw clockwise will increase spring pressure and therefore "hardens" shifter lock action. Conversely turning screw counter-clockwise "softens" lock action.

The set screw is located on the same side as shifter lever.



1. Shifter lever
2. Shifter plate
3. Set screw (shifter lock)

ASSEMBLY

When reinstalling throttle / shifter control to boat, be careful not to bend cables.

Ensure everything works properly.

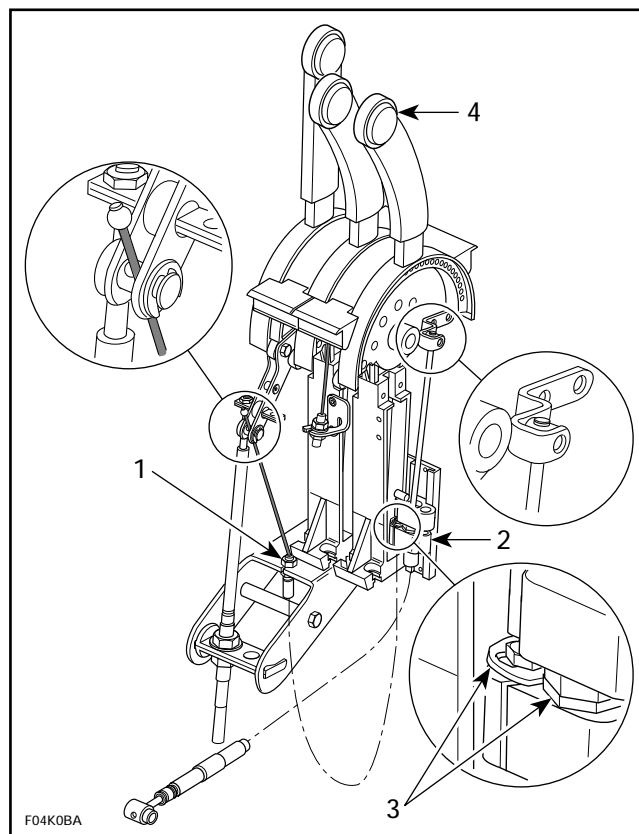
VTS Auto-Centering Feature

GENERAL

This feature allows the jet pump nozzle to be auto-centered by the water flow whatever the position of the VTS lever while the shifter is in neutral or in reverse. This contributes to keep the right water flow direction toward the reverse gate for proper neutral and reverse efficiency.

ADJUSTMENT

Place the shifter in FORWARD position. Adjust the slider mechanism cable so that a tension in the cable maintains the slider blocks together. Check the operation by moving the VTS lever. The blocks must remain together while the nozzle responds to the lever movement via the inner part of the cable.



TYPICAL

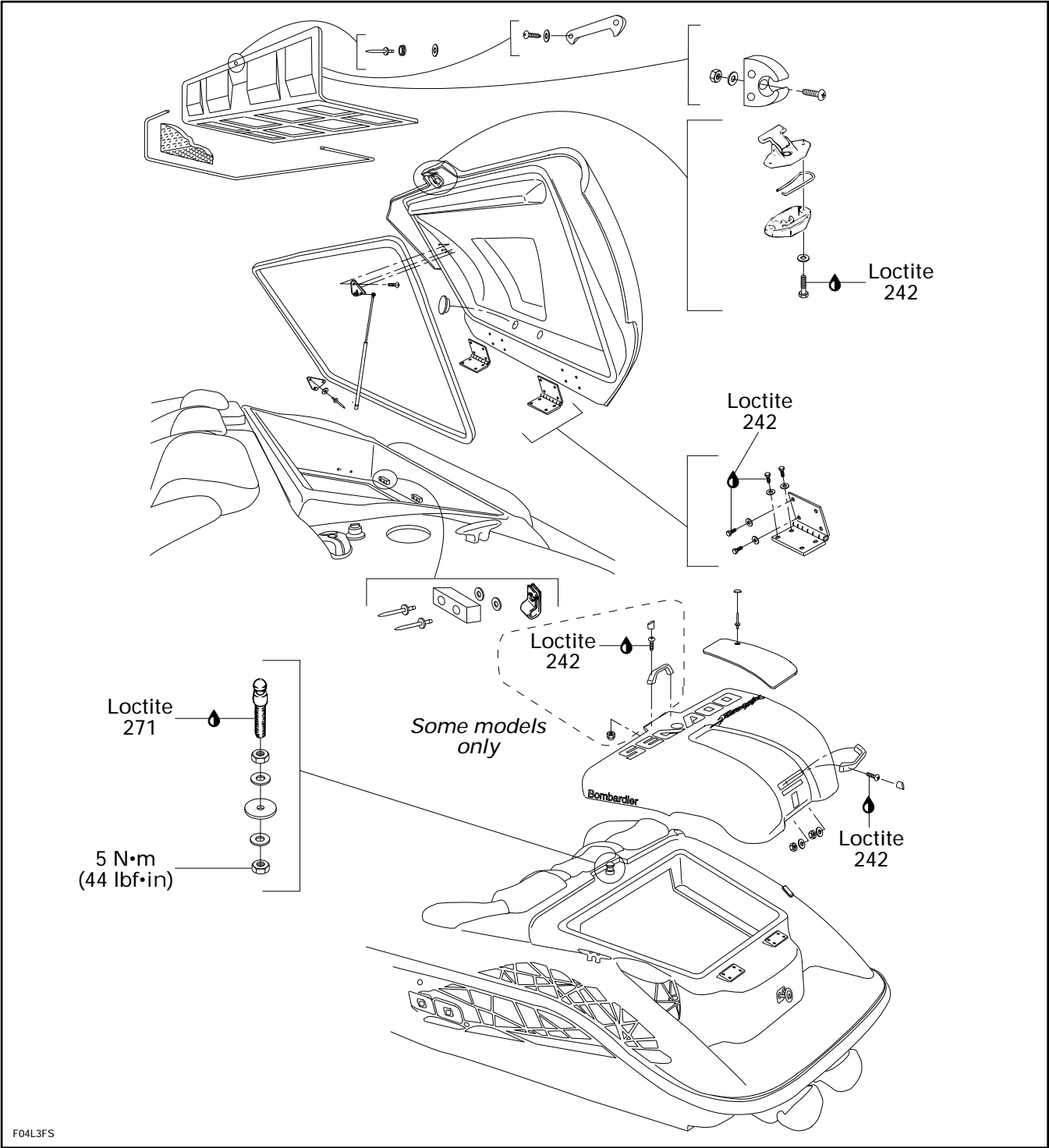
1. Adjust the slider mechanism cable here while shifter is at FORWARD
2. Adjust cable so that blocks hold together with a tension in the cable
3. Ensure cable locking devices are properly installed
4. VTS lever

Place the shifter in NEUTRAL or in REVERSE. Check the operation by moving the VTS lever. The lower slider block should move over the outer shell of the VTS cable while the nozzle must not move.

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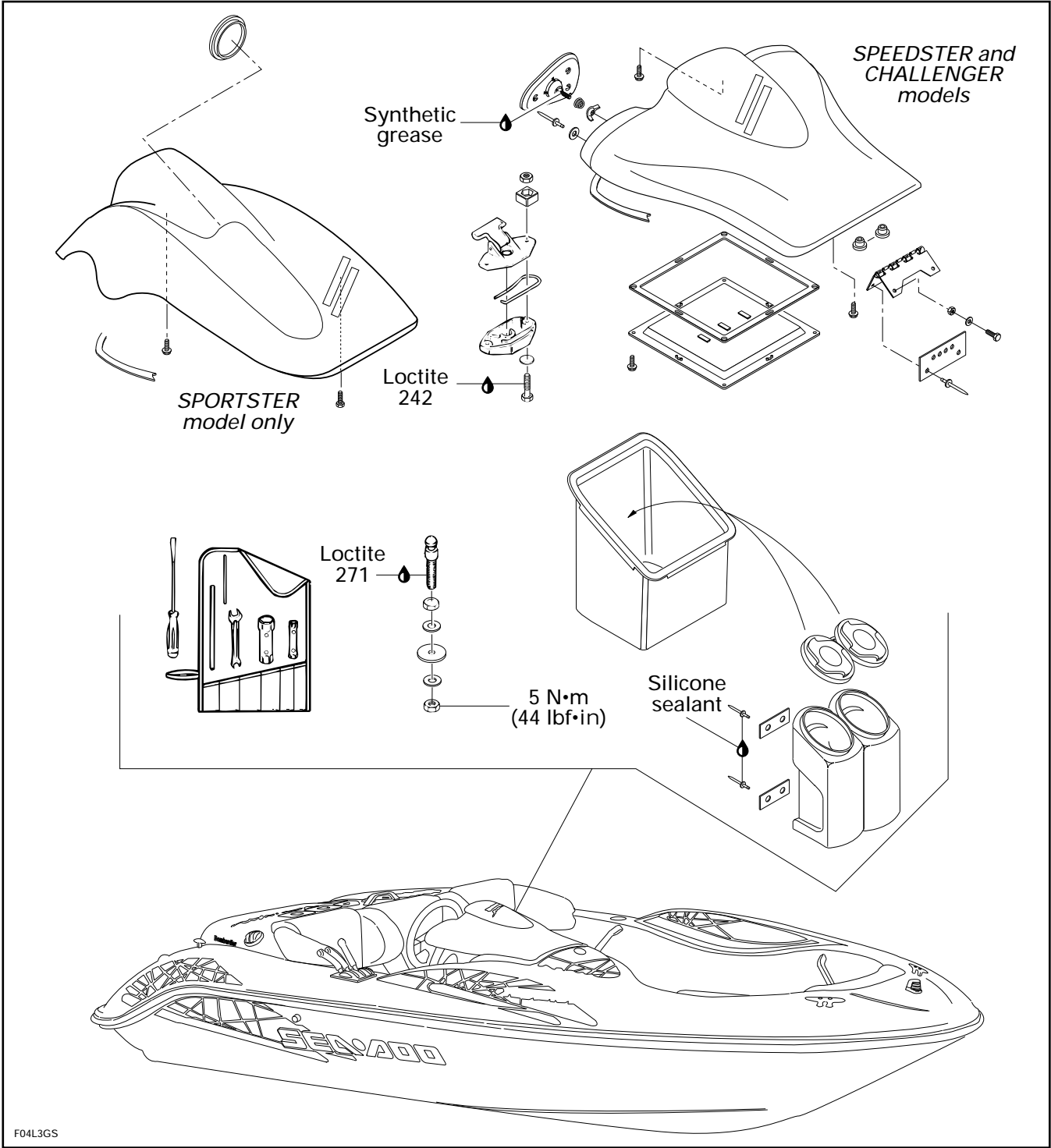
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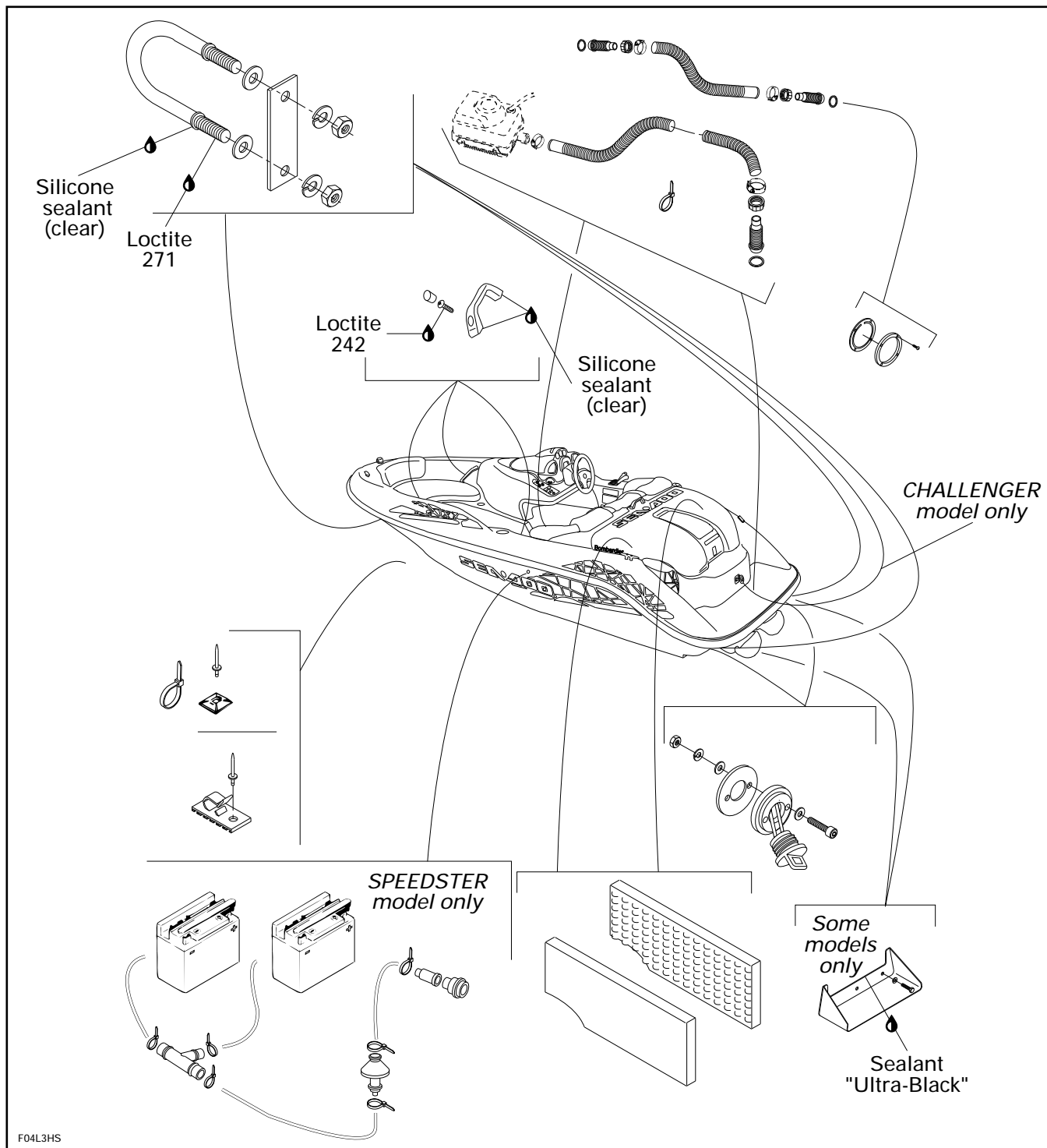
F04L3FS

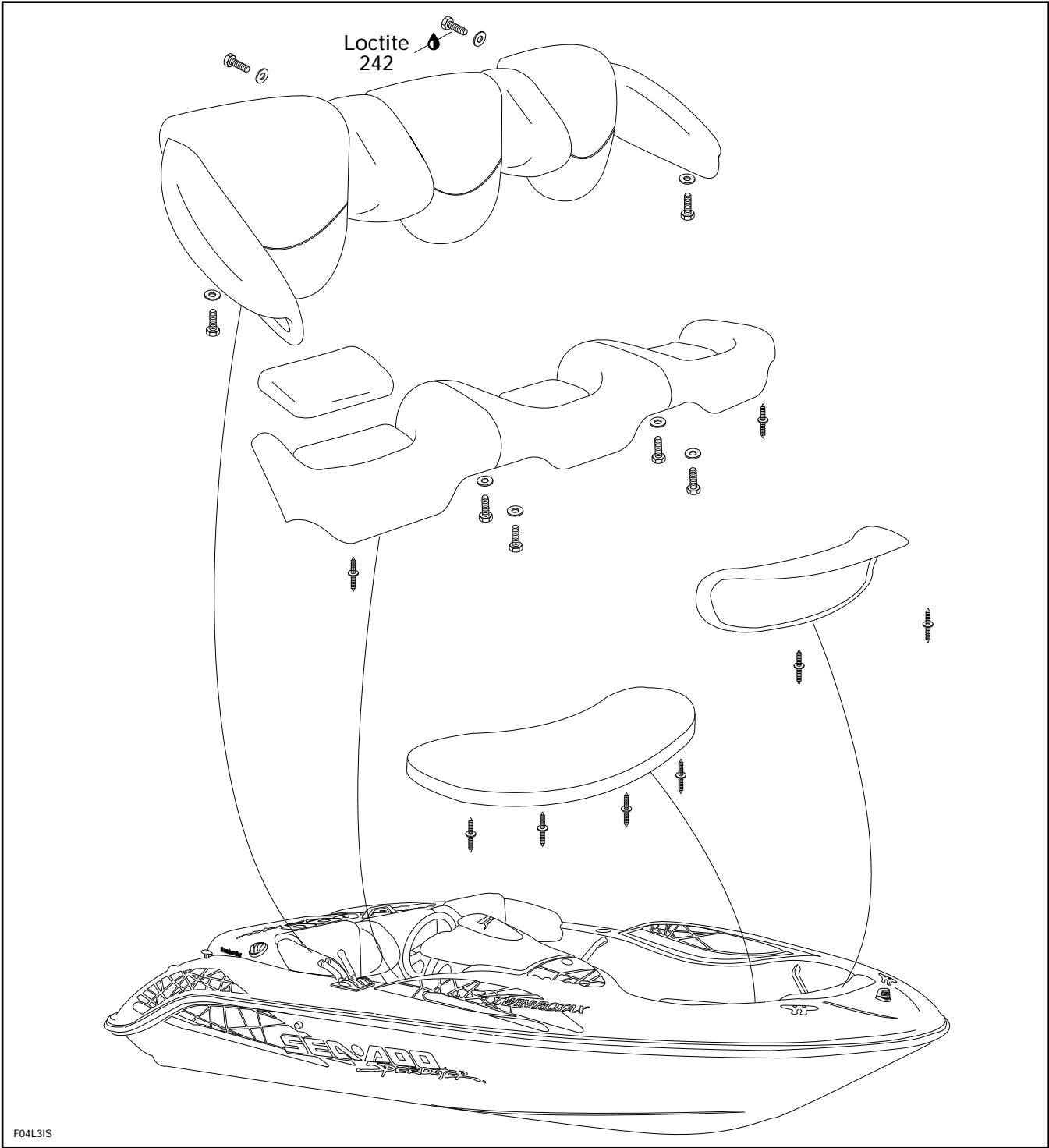
Section 11 HULL / DECK
Sub-Section 01 (COMPONENTS)



F04L3GS

Section 11 HULL / DECK
Sub-Section 01 (COMPONENTS)





F04L3IS

BUMPER REPLACEMENT

Bumper and Trim

○ **NOTE** : Prior to beginning job, place bumper trim in a container of hot water to soften material and ease installation. In cool weather, bumper rail may be warmed too.

1. Remove bumper cover at rear of boat.
2. Remove trim from bumper rail.
3. Drill pop rivets to remove bumper rail.
4. Mark hole positions on body.
5. Using a 4.80 mm (3/16 in) drill bit, drill a first hole through bumper rail at any rear end. Use locating mark as a guide and install a rivet.

▼ **CAUTION** : When drilling, be careful not to damage bumper rail and / or hull.

○ **NOTE** : Check condition of silicone joint between hull and body. Reseal as necessary with sealant adhesive (293 800 033) or equivalent without acetic acid vapors.

6. Position bumper rail properly onto body all around coming back to other rear end and cut excess length if necessary.

○ **NOTE** : Masking tape may be used to temporarily retain bumper rail ahead of your work.

7. Install trim using soapy water. Gently tapping trim with a rubber hammer will help to fit trim in rail.
8. Reinstall bumper cover.
9. Check fit between bumper and body. Fill gaps with silicone sealant as necessary.

DECAL REPLACEMENT

Removal

Using a heat gun, warm up one end of decal for a few seconds until decal can roll off when rubbing decal edge with your finger.

Pull decal slowly and when necessary apply more heat to ease removal on the area that has to be peeled off.

If decal tears while pulling off, it has to be heated for a few seconds longer. If decal tends to stretch while pulling off, stop heating and wait a few seconds to let it cool, then peel it off.

Installation

There are 2 types of decals used on jet boat. One has a protective film on back side and the other has a protective film on both sides. They are used on 3 types of materials ; plastic, gelcoat and metal.

Decals Having a Protective Film on Back Side Only

These decals usually contain written information (ex. : warning) and are used on gelcoat or metal.

Clean surface with a good solvent such as ACRYLICLEAN DX 330 from PPG or equivalent (refer to manufacturer instructions).

Using a pencil and the new decal as a template, mark the area where decal will be located.

Remove half of the decal back protective film and align decal with marks. Start sticking it from center and remove the other half of the film to stick it completely. Carefully squeegee decal beginning at center and working outward using, firm, short, overlapping strokes.

Decals Having a Protective Film on Both Sides

These decals usually contain graphics and are used on gelcoat or plastic.

Installation on Gelcoat

Clean surface with a good solvent such as ACRYLICLEAN DX 330 from PPG or equivalent (refer to manufacturer instructions).

For best result apply an activator (P / N 293 530 036) to prepare the surface using a clean cloth. After a few seconds, when the activator evaporates, the surface is ready.

Using a pencil and the new decal as a template, mark the area where decal will be located.

For better adhesion a dry application is recommended, however, to ease decal installation a mild solution of soapy water can be sprayed over surface where decal will be installed.

Remove back protective film from decal and align decal with marks. When well aligned squeegee decal beginning at center and working outward using, firm, short, overlapping strokes.

Remove protective film once decal has adhered to hull.

Installation on Plastic Front (Front Storage Cover)

Clean surface with isopropyl alcohol.

Using a pencil and the decal as a template, mark the area where decal will be located.

Gently heat the marked surface with a flame (a heat gun does not work). Heat until the material begins to change (color and texture).

Apply an activator (P / N 293 530 036) to prepare the surface using a clean cloth. After a few seconds, when the activator evaporates, the surface is ready.

CAUTION : Do not use soapy water to locate decal on plastic parts.

Remove back protective film from decal and carefully align decal with marks. When well aligned squeegee decal beginning at center and working outward using, firm, short, overlapping strokes.

Remove protective film once decal has adhered.

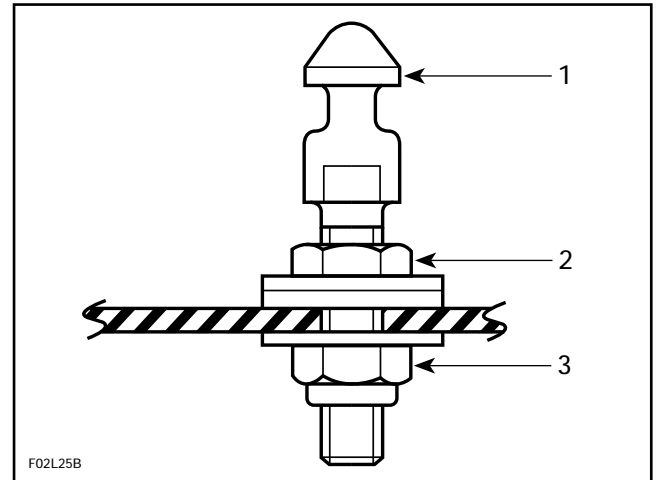
REAR STORAGE COMPARTMENT COVER GAS SHOCKS

If cover does not lift by itself, when latch is released, replace gas shock(s). Each shock should be checked individually by detaching them one at a time. At shock installation, position it so that the piston rod is at bottom.

LATCH ADJUSTMENT

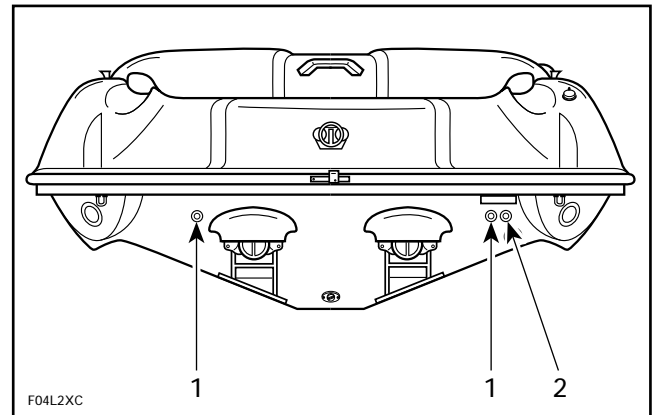
Front and rear storage compartment cover latches are adjustable. If cover is not tight enough or if it is hard to close, adjust as necessary.

1. Using a heat gun, heat nuts of lock pin to release Loctite bond.
2. Turn adjustment nut as required and check cover fit and locking action.
3. When adjustment is satisfactory, temporarily remove lock nut and apply Loctite 271 (red) on lock pin threads.
4. Torque nut to 5 N•m (44 lbf•in).

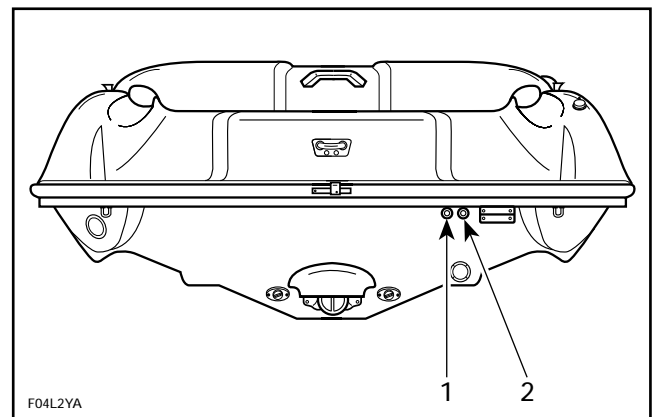


1. Locking pin
2. Adjuster nut
3. Lock nut. Torque to 5 N•m (44 lbf•in)

DRAIN / COOLING OUTLET(S) LOCATION



1. Engine cooling system outlet(s) / flushing connector(s)
2. Bilge pump outlet



1. Engine cooling system outlet(s) / flushing connector(s)
2. Bilge pump outlet

DRAIN REPLACEMENT

Bilge Pump Drain

- Disconnect drain tube from transom fitting.
- Cut locking ties all along drain tube from transom toward bilge pump.
- Disconnect drain tube from bilge pump and remove tube.
- Cut new tube to proper length.
- Reconnect tube at each end and resecure tube with locking ties.
- Ensure tube does not leak in bilge.

Deck Drain

- Disconnect drain tube from transom fitting.
- Cut locking ties all along drain tube from transom toward deck storage compartment.
- Remove throttle / shifter controller to gain access.
- From the controller opening, disconnect drain tube from deck fitting.
- Cut new tube to proper length.
- Reconnect tube at each end and resecure with locking ties.
- Ensure tube does not leak in bilge.


Scupper Valve

Check rubber valve condition (cracks, tears etc.), and operation (should remain closed or near to closed). Replace as necessary.

If scupper valve cover has been removed, ensure to position tabs on top at reinstallation. See illustration above.

SEAT REMOVAL / INSTALLATION

 **NOTE** : A screwdriver may be used carefully to pry seat / backrest out.

 **CAUTION** : Ensure to protect body prior to prying.

Whenever removing seat and / or backrest, always replace darts prior to reinstalling.

Rear Seat

Carefully pry sides of seat to release the darts.

The 4 retaining screws can be reached from engine compartment underneath seat.

Rear Backrest

The 4 rear retaining screws can be reached from engine compartment. Remove electrical box to reach starboard retaining screw.

The starboard (RH) retaining screw can be reached by removing throttle / shifter controller.

The port (LH) retaining screw can be reached by removing the cup holder.

Apply Loctite 242 (blue) on screw threads at assembly.

Front Seat

Carefully pry seat up to release the darts.

Front Backrest

Carefully pry bottom of backrest to release the darts. Lift backrest to remove.

Spotter Seat

Challenger

BACKREST

The backrest is retained by 3 screws which can be accessed by lifting the cooler cover.

SEAT

Start to pry out darts in the corners of the seat below the backrest area. Lift the front portion of the seat to release the retaining bracket and at the same time, pull the seat out.

REPAIR


HULL AND DECK REPAIR


GENERAL

Gelcoat is the smooth and durable cosmetic finish which coats the fiberglass hull and body of a Sea-Doo jet boat. It also provides a protective barrier against water and sun. It consists of a mixture of resin, pigment (coloring), fillers, monomers and catalyst which is sprayed into the mold.

The body and hull of the Sea-Doo jet boat are constructed of chopped fiberglass, saturated with resin. It is sprayed on the layer of gelcoat along with pieces of fiberglass mat, cloth and woven roving which are added at required areas. This type of construction is very accommodating for high quality repairs. With patience, the proper techniques and materials, a damaged area can be restored to an original finish.

The content is not intended to replace the use of a complete fiberglass and gelcoat repair manual. Its main purpose is to help you understand what factors are involved when making a damage assessment or estimate.

 **NOTE :** Fiberglass repair kit is available through automotive or marine suppliers. Gelcoat repair kits are available through regular channel. Refer to SERVICE TOOLS AND PRODUCTS 01-03 section.

 **WARNING :** Protect skin, wear gloves when in contact with resin, hardeners and gelcoat. A barrier skin cream may also be used. Do not expose area to open flame or lit cigarette. Some of the materials are flammable. Protect eyes, wear safety glasses when grinding, sanding or spraying. Use a dust mask when sanding or grinding. When spraying wear a respirator or paint mask. Always read warning labels on products.

AIR BUBBLES

Possible Cause

- Air pocket trapped between layers of laminate and gelcoat.

1) Preparation of Surface

Remove all of the damaged gelcoat surrounding the air bubble with a putty knife or preferably a carbide grinding tip. Make sure all loose and weak areas are completely removed. Sand a small area of the gelcoat surface with 220-grit sandpaper. If needed, sand the cavity itself. These areas must have a rough surface to allow the gelcoat putty to bond properly.

2) Filling the Cavity

The prepared surface must be cleaned with acetone on a cloth. Use the Bombardier gelcoat repair kit (P / N 295 500 100). Follow the mixing instructions in the kit when preparing the gelcoat putty.

Carefully mix the required amount while making sure there are no air bubbles in the mixture. With a putty knife fill the repair area and cover with plastic film. Curing time may depend on temperature, amount of putty and percentage of catalyst. After 2 hours, press lightly on the surface with fingers to test the hardness. When the area becomes hard, remove the plastic film.

3) Sanding

Begin block sanding the patch with 320-grit sandpaper until you come close to the original surface. Remove dust with a water soaked cloth and continue sanding with a 400-grit wet paper. Finish wet sanding with a 600-grit to remove deeper scratches. If needed you can wet sand with finer grit paper such as 1000-grit.

4) Buffing and Waxing

Buff the surface using a heavy duty polisher with a buffing pad. Make sure the pad is free of dirt or you may damage the gelcoat. Carefully begin buffing with a white medium compound RM 856. Finish off using a fine RM 852 compound. While buffing, pay close attention to avoid overheating the surface.

BLISTERS

Possible Causes

- Inert catalyst.
- Improper catalyst / gelcoat ratio.

A blister is a visible bump on the Sea-Doo jet boat surface that may not necessarily come right through the gelcoat layer. In the case of only a few blisters, you may follow the same repair procedure as for air bubbles. If they are numerous and in close concentration, you may have to spray liquid gelcoat to achieve proper repair. This procedure is covered in the next problem.

▼ **CAUTION** : Ensure blistered area is completely dry before attempting repairs.

MINOR GELCOAT FRACTURES

Possible Causes

- Flexing of fiberglass laminate.
- Gelcoat thickness.
- Direct result of impact.

In case of fractures which have not penetrated past the gelcoat layer, the repair concerns the gelcoat only. If flex cracking or impact are evident, then additional reinforcement may be necessary. This subject will be covered in the next problem.

1) Preparing the Surfaces

Small Fractures :

Open the cracks up with a sharp triangular can opener or preferably a carbide tipped die grinder. The V groove will provide a good bonding area for the gelcoat. With 220-grit sandpaper, sand the sides of the notched out areas.

Numerous Fractures :

Using a grinder with a 24-grit disk, remove the gelcoat. Sand the area edge with 220-grit sandpaper.

2) Filling the Repair Area

Small Fractures :

Refer to the same procedure as in the air bubbles.

Numerous Fractures Over Large Surface :

Prepare the area for spray application of liquid gelcoat. Wipe down the surface with acetone. Mask the area off to protect the boat from overspray.

Mix the needed quantity of gelcoat and catalyst according to suppliers recommendations. The gelcoat can be thinned with acetone up to 10%. If it needs more consistency you can add cabosil.

Make sure that the air supply is free of oil, dirt and water.

Test spray the gelcoat mixture on paper to verify its consistency and pattern. You may have to apply 5 or 6 coats to cover the area properly. Overlap each coat further than the last, leaving at least 30 seconds between passes. Avoid trying to coat the surface with only a few heavy coats, this will not allow the gelcoat to dry properly.

Apply a coat of polyvinyl alcohol to seal off the air and protect the gelcoat surface from dust. PVA speeds up the curing process because gelcoat will not cure properly when exposed to air.

3) Sanding

Wash the polyvinyl alcohol off with water. Depending on the size of the area repaired, you can either block sand as per previous procedure or you may use an air sander. Sand the surface down with progressively finer grits of sandpaper until the desired finish is achieved.

4) Buffing and Waxing

Buff the surface using a heavy duty polisher with a buffing pad. Make sure the pad is free of dirt or you may damage the gelcoat. Carefully begin buffing with a white medium compound RM 856. Finish off using a fine RM 852 compound. While buffing, pay close attention to avoid overheating the surface.

COMPOUND FRACTURES

Possible Causes

- Thickness of fiberglass laminate.
- Direct result of impact.

Compound fractures are those that have gone past the gelcoated surface and in through the layers of fiberglass laminate. Two types of repairs have to be performed. The first is to restore the structural integrity of the damaged area. Fracture types can vary from a simple crack to a large hole. Usually, fiberglass reinforcement becomes necessary, especially if the fracture can be attributed to weakness. The final part of the repair is the gelcoating, which cannot be done until the interior and exterior laminate surfaces have been repaired.

Outside :

Remove the damaged gelcoat and fiberglass with a 24-grit disk using a power sander. Grind outward at least 2 inches from the fracture to allow the patch to bond to strong material. Cut enough pieces of fiberglass mat necessary to build up the area. The pieces should be cut so they overlap each other by at least a half inch. For a smoother finish, the last layer should be fiberglass cloth. If the fracture is small enough all you may have to do is fill the area with an epoxy filler.

Inside :

For the interior repair, you can grind more. This will allow for more fiberglass material which will strengthen the area. If the fracture opening is too large after surface preparation, you may need a backing support to cover the opening. Cut alternating pieces of fiberglass mat and cloth in overlapping sizes.

Patching the Repair Area

Outside :

The outside should be done first. Wipe clean the area with acetone on a cloth, then mask off area. For a small crack use an epoxy filler in the same way you would use Bombardier's gelcoat repair putty. When laying up a larger area you will use mat, cloth and fiberglass resin and hardener. Use a clean container to mix the resin, mix only what you will need. Follow the recommended catalyst ratio.

Using a clean paintbrush, brush the mixed resin on the surface. Place the smallest piece of mat over the fracture and then wet out the mat. Follow with the remaining pieces of mat and final layer of cloth. While wetting the pieces make sure you work the air bubbles out and saturate all the pieces evenly. Try to work quickly, you may only have 15 or 20 minutes. You may clean the brush with acetone.

Wait until the repair has hardened before moving on to the interior repair. If the size of the opening is too large for the pieces to maintain the proper shape, you will have to use a backing support. It is a shaped piece of cardboard that fits flush to the interior surface and has a plastic layer on the repair side. It is held in place by tape or a support.

Inside :

Wipe down the area with acetone on a cloth. Apply the same procedure as for outside repair when laminating the alternating pieces of fiberglass material. If a backing support was used, remove it before starting the repair. After the area has hardened, remove sharp edges of material from surface. If required paint the surface.

Sanding

Outside :

This surface will have to be prepared for application of gelcoat. The size of the area will determine the gelcoating procedure to be used. Refer to the repair procedure for minor gelcoat fractures.

Buffing and Waxing

Refer to the buffing and waxing for minor gelcoat fractures. If painting the exterior is preferred, refer to Painting sub-section 03.

TOOLS AND MATERIALS LIST

Tools

- safety glasses
- air mask
- white cloths
- sanding block
- putty knife
- plastic film
- stirring stick
- cover sheets (for Sea-Doo)
- scissors
- buffing pad
- heavy-duty polisher
- power sander
- paint brush
- plastic container (mixing)
- spray gun
- plastic squeegee

Materials

- fiberglass mat
- fiberglass cloth
- polyester resin
- cardboard
- masking tape
- sandpaper
- (100-grit, 220-grit, 220-grit, 320-grit, 400-grit, 600-grit, 1000-grit)
- 24-grit sanding disks
- Bombardier gelcoat putty
- Bombardier liquid gelcoat
- acetone
- cabosil
- epoxy filler
- medium compound (white)
- fine compound (white)
- wax

PAINTING

The following was prepared in conjunction with PPG Industries Inc. It contains a list of SEA-DOO jet boat parts with their respective PPG color codes and 2 painting procedures ; CONCEPT™ the most commonly used and DELTA™ (with low VOC) mainly used in California.

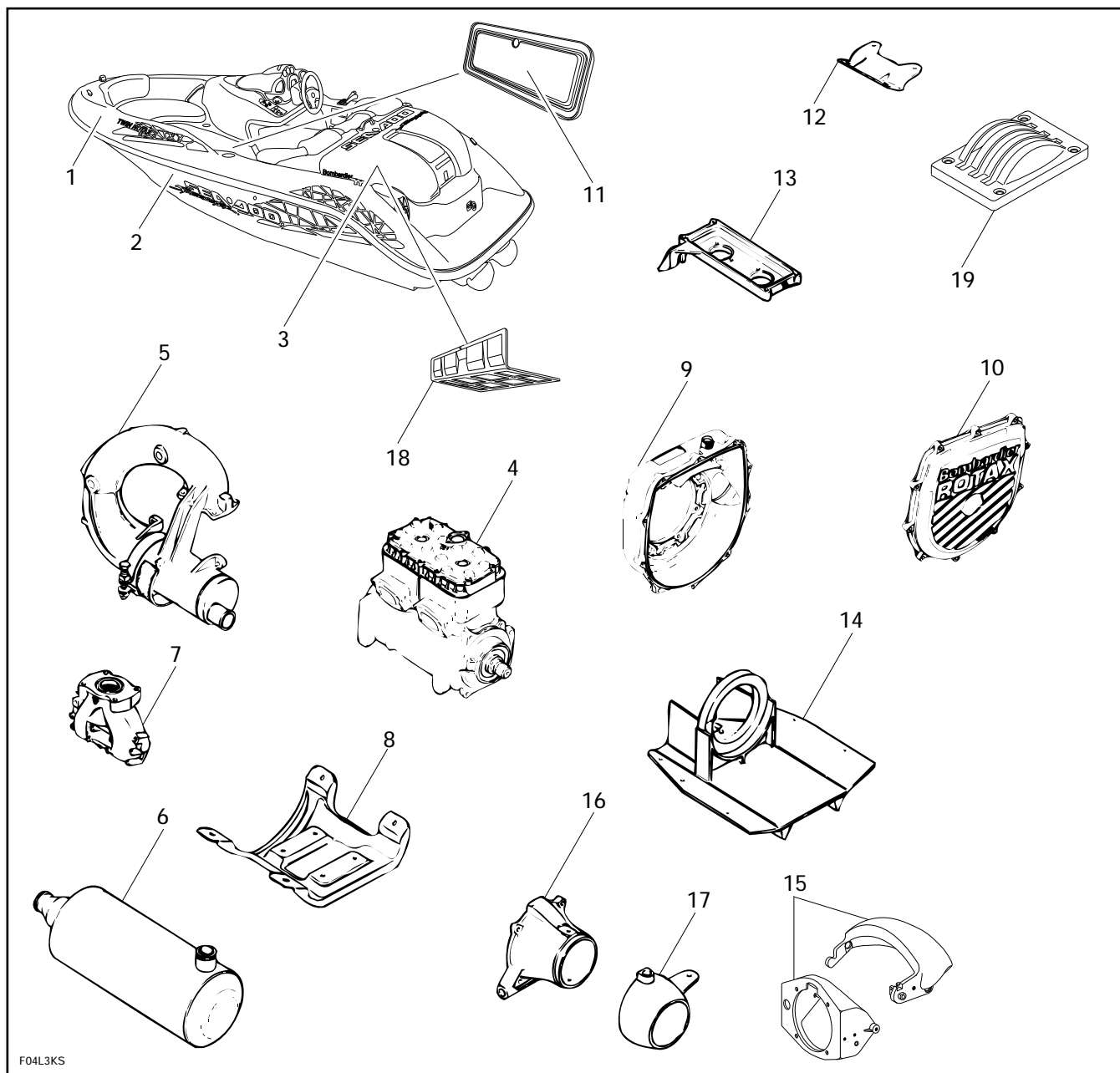
PPG Industries Inc. sells paint and related products and these are **not** available from Bombardier Inc. To find your nearest PPG dealer, dial one of the following numbers.

NORTH AMERICA	CANADA Quebec Phone : 1-800-363-2816	All Other Provinces Phone : 1-905-855-5802 Communications are available in english and french.
	U.S.A. Phone : (216) 572-6100 This phone number is also good for all countries. Communications are available in english, french and spanish.	
EUROPE	DENMARK Phone : 45-31-54-9211	PORTUGAL Phone : 351-230-17-43
	FRANCE Phone : 33-1-48-35-7777 33-27-14-9700 33-27-14-4600	SPAIN Phone : 34-3-588-2000 34-3-711-51-54 34-6-154-7035 34-83-54-0400 / 04
	GERMANY Phone : 49-202-788-1	SWEDEN Phone : 46-479-14-445
	ITALY Phone : 39-81-831-1222 39-2-37-701 39-131-7701	UNITED KINGDOM Phone : 44-21-455-9866 44-926-410-255
PACIFIC RIM	JAPAN Phone : 81-3-3280-2851	KOREA Phone : 82-32-529-8141 82-32-523-8600 82-51-624-8221 82-2-792-2477

PPG paint for Sea-Doo jet boat is not available in spray can. For best result it must be applied by a professional painter.

For fast touch up on metallic and gelcoat surfaces, refer to the appropriate Bombardier *Sea-Doo Jet Boat Parts Catalog*, it contains a few spray can part numbers.

PARTS THAT CAN BE PAINTED



1. Body
2. Hull
3. Rear Storage Cover
4. Engine
5. Tuned Pipe
6. Muffler
7. Exhaust Manifold
8. Engine Support
9. Ignition Housing

10. Ignition Housing Cover
11. Deck Storage Compartment Cover
12. Flame Arrester Support
13. Flame Arrester Base
14. Ride Shoe
15. Reverse Gate and Support
16. Venturi
17. Steering Nozzle
18. Rear Storage Compartment Tray
19. Throttle / Shifter Controller Cover

PART	PPG COLOR Nos. FOR SEA-DOO JET BOATS		
	SPORSTER	CHALLENGER	SPEEDSTER
1.Body	Super White 98260	Super White 98260	Super White 98260
2.Hull	Super White 98260	Super White 98260	Super White 98260
3.Rear Storage Cover	Super White 98260	Super White 98260	Super White 98260
4.Engine	White 98209	White 98209	White 98209
5.Tuned Pipe	Purple 59962	Purple 59962	Purple 59962
6.Muffler	Purple 59962	Purple 59962	Purple 59962
7.Exhaust	White 98209	White 98209	White 98209
8.Engine Support	Black 9551	Black 9551	Black 9551
9.Ignition Housing	White 98209	White 98209	White 98209
10.Ignition Housing Cover	White 98209	White 98209	White 98209
11.Deck Storage Compartment Cover	Super White 98260	Super White 98260	Super White 98260
12.Flame Arrester Support	White 98209	White 98209	White 98209
13.Flame Arrester Base	Black 9551	Black 9551	Black 9551
14.Ride Shoe	Black 9551	Black 9551	Black 9551
15.Reverse Gate and Support①	Black 9551	Black 9551	Black 9551
16.Venturi①	Black 9551	Black 9551	Black 9551
17.Steering Nozzle	Black 9551	Black 9551	Black 9551
18.Rear Storage Compartment Tray	Super White 98260	Super White 98260	Super White 98260
19.Throttle / Shifter Controller Cover	Super White 98260	Super White 98260	Super White 98260

① Aluminum parts only



NOTE : Due to natural discoloration it may be necessary to completely repaint the part.

CONCEPT™ PAINTING PROCEDURE

For additional information refer to *PPG P-Bulletin* no. 168.

SURFACE PREPARATION

Prepare and clean surface consistent with good painting practices.

Primer

DP Epoxy Primer / DP 401 Catalyst ; DX 1791 / 1792 (Prime before topcoating).

Primer Surfacer

K36 / K201, K200 / K201 or DZ KONDAR® Primer Surfacers.



NOTE : KONDAR must be sealed before applying CONCEPT™ color.

Sealer

KTS30 2K Sealer, DP Epoxy Primer reduced as a sealer or DAS 1980 or DAS 1987.

Direct Gloss Color

How to Mix

Standard Air Dry : Mix CONCEPT™ Color 2:1:1 - 2 parts color with 1 part DT Reducer best suited to shop temperatures and 1 part DU 4 Hardener below 29°C (85°F) or DU 5 Hardener above 29°C (85°F).

Standard Force Dry : Mix CONCEPT™ Color 2:1:1 - Application temperatures below 29°C (85°F) use DU 5 Hardener, above 29°C (85°F) use DU 6.

Medium Solids (MS) Application : For faster film build, when using solid colors, mix 2 parts CONCEPT™ color with half part DT Reducer and 1 part DU 5 or DU 6 Hardener. Select the DT Reducer appropriate for shop temperature.

Pot Life

Pot life of ready-to-spray CONCEPT™ color is 6 to 8 hours at 21°C (70°F). Medium solids option is 2 to 4 hours at 21°C (70°F).

FULL PANEL AND OVERALL REPAIRS

Application

Apply 1 medium wet coat and give 5-10 minutes flash, followed by 2 wet coats with 15 minutes flash time between each coat. Adjust metallic on the last full wet coat. If necessary, apply a mist coat. For medium solids option apply 2 full wet coats.

Air Pressure

275-345 kPa (40-50 PSI) at the gun.

Dry Time

- Dust free : 30 minutes.
- Tack free : 2 to 3 hours.
- Tape print free : 6 hours.
- Dry to handle : 6 to 8 hours at 21°C (70°F).
- Force dry : 40 minutes at 60°C (140°F).

Faster dry times may be obtained by using 15 mL (1/2 oz) of DXR 81 Accelerator per sprayable quart, however, the pot life is reduced to 2 hours.

SPOT / PANEL REPAIRS

Application

Spray medium wet coat of color on the repair area and allow 5-10 minutes flash time. Apply 2 additional full coats until hiding is achieved, extending each coat beyond the previous coat. Flash 15 minutes between each coat. For medium solids option apply 2 full wet coats.

Blending

Add DT 95 Reducer to a second gun cup. Reduce the fluid feed of the gun and lower the air pressure to 207 kPa (30 PSI). Dust the dry edge until a slight wet look appears, then stop. Or mix reduced and catalyzed color with equal parts of reduced and catalyzed CONCEPT™ DCU 2020 Clear.

DELTATM PAINTING PROCEDURE (with low VOC, mainly in California)

For additional information refer to PPG P-Bulletin no. 157.

SURFACE PREPARATION

Primer : DELTATM PRIME DPU 166.

DELTATM 2800, COLOR

How to Mix

Mix DELTATM 2800 2:1, 2 parts Colors to 1 DU 6 Catalyst.

Application

Apply 2 coats of DELTATM Polyurethane Color. Apply the first coat at 1.5 -1.8 wet mils. Allow a minimum of 15 minutes flash time prior application of the second coat. Apply a second coat of DELTATM using the same technique as the first application, paying strict attention to gun set up and proper equipment choices.

RECOMMENDED SPRAY EQUIPMENT

GUN MANUFACTURER	DE VILBISS	BINKS	GRACO	HVLP
GUN MODEL	JGA	62	800N	Can Am Model 900
FLUID TIP SIZE	FF 1.4 mm (0.055 in)	63D 1.5 mm (0.059 in)	02N 1.2 mm (0.047 in)	HT no. 9072 2.5 mm (0.098 in)
AIR CAP	797 / 264	63 PW	02 / 03	C9062
GUN DISTANCE	25 - 30 cm (10 - 12 in)	25 - 30 cm (10 - 12 in)	25 - 30 cm (10 - 12 in)	25 - 30 cm (10 - 12 in)
FLUID DELIVERY	227 - 340 mL / min. (8 - 12 oz / min.)	227 - 340 mL / min. (8 - 12 oz / min.)	227 - 340 mL / min. (8 - 12 oz / min.)	227 - 340 mL / min. (8 - 12 oz / min.)
AIR PRESSURE (AT-THE-GUN)	414 - 517 kPa (60 - 75 PSI)	414 - 517 kPa (60 - 75 PSI)	414 - 517 kPa (60 - 75 PSI)	62 kPa (9 PSI)

Dry Time at 21°C (70°F)

- Dust free : 25-35 minutes.
- Tack free : 2-1/2 to 3 hours.
- Tape / Sand : Overnight.

Force Dry

Allow 20 minutes purge time at 27-32°C (80-90°F) before bake. Bake 75 minutes at 65°C (150°F) or 40 minutes at 82°C (180°F). Allow to cool after force dry, before sanding or taping.

ALL MODELS

ENGINE		SPORSTER (5895)	SPEEDSTER (5894)
Number of engine		1	2
Engine type		Bombardier-Rotax 717, water cooled	
Induction type		Rotary valve	
Exhaust type	Type	Water cooled, water injected	
	Water injection fittings	3.5 mm (.139 in)	
Starting system		Electric start	
Lubrication	Fuel / oil mixture	VROI (Variable Rate Oil Injection)	
	Oil injection pump	Gear driven	
	Oil type	Bombardier-Rotax injection oil	
Number of cylinders		2	
Bore	Standard	82.00 mm (3.228 in)	
	First oversize	82.25 mm (3.238 in)	
	Second oversize	82.50 mm (3.248 in)	
Stroke		68 mm(2.68 in)	
Displacement		718.2 cm³ (43.81 in³)	
Compression ratio	Uncorrected	12.25 : 1	
	Corrected	6.2 : 1 ①	
Engine maximum torque		91 N•m (67 lbf•ft) @ 6250 RPM	
Cylinder head warpage (maximum)		0.05 mm (.002 in)	
Piston ring type and quantity		1 Semi-Trapez — 1 Rectangular	
Ring end gap	New	0.25 - 0.40 mm (.010 - .016 in)	
	Wear limit	1.00 mm (.039 in)	
Ring / piston groove clearance	New	0.025 - 0.070 mm (.001 - .003 in)	
	Wear limit	0.2 mm (.008 in)	
Piston / cylinder wall clearance	New	0.06 - 0.08 mm (.002 - .003 in)	
	Wear limit	0.20 mm (.008 in)	
Cylinder taper (maximum)		0.10 mm (.004 in)	
Cylinder out of round		0.08 mm (.003 in)	
Connecting rod big end axial play	New	0.39 - 0.74 mm(.015 - .029 in)	
	Wear limit	1.2 mm (.047 in)	
Crankshaft deflection (center)		0.08 mm(.003 in) ②	
Rotary valve timing	Opening	147° ± 5 BTDC	
	Closing	65° ± 5 BTDC	
Rotary valve duration		159°	
Crankcase / rotary valve gap		0.25 - 0.35 mm (.010 - .014 in)	
Connecting rod / crankshaft pin radial clearance	New	0.01 - 0.02 mm (.0004 - .0008 in)	
	Wear limit	0.050 mm (.002 in)	
Connecting rod / piston pin radial clearance	New	0.003 - 0.012 mm (.00012 - .00047 in)	
	New limit	0.015 mm (.00059 in)	
ADDITIONAL INFORMATION :			
① Squish gap : 0.9 - 1.3 mm (.035 - .051 in)			
② MAG side : 0.05 mm (.002 in) PTO side : 0.03 mm (.001 in)			

Section 12 TECHNICAL DATA

Sub-Section 01 (ALL MODELS)

ELECTRICAL		SPORTSTER (5895)		SPEEDSTER (5894)		
Magneto generator output		160 W @ 6000 RPM or 4 A @ 2000 RPM (each engine on Speedster)				
Ignition system type		CDI (Capacitor Discharge Ignition)				
Spark plug	Make and type		NGK BR8ES			
	Gap		0.55 mm (.021 in)			
Ignition timing (BTDC)	mm (in)		2.59 (.102)			
	Degrees		20° ± 1 ①			
Generating coil		40 - 76 Ω				
Battery charging coil		.05 - .06 Ω				
Ignition coil	Primary		.34 - .62 Ω (not measurable)			
	Secondary		9 - 15 kΩ			
Engigne RPM limiter setting		7000 (± 50) RPM				
Battery		Not supplied ②		2 batteries (Yuasa) 12 V, 19 A•h connected in parallel		
Fuse	MPEM (Multi-purpose electronic module) supply		5 A		2 x 5 A	
	Fuse block supply		20 A			
	Charging system		15 A		2 x 15 A	
	Blower		7.5 A			
	Bilge pump		3 A			
	Lighting system		3 A			
	Gauges		5 A			
	Additional accessories		10 A			
ADDITIONAL INFORMATION :						
① Engine cold @ 6000 RPM with shifter in forward or reverse position.						
② Recommended : Exide RV24-130, 12 V, 25 A•h (130 minutes reserve) or RV24-160 (160 minutes) or equivalent. Battery pot : On top. Round taper type. Battery maximum allowed size : 285 mm (11-1/4") long x 190 mm (7-1/2") wide x 238 mm (9-3/8") high.						
◆ WARNING : Never use automotive type battery. Its mechanical construction does not allow to meet the shock conditions where boats operate. Only use the type of battery recommended.						
CARBURETION		SPORTSTER (5895)		SPEEDSTER (5894)		
Carburetor	Type		Mikuni Diagram BN 381-37			
	Quantity		2		2 per engine	
Main jet		130				
Pilot jet		67.5				
Adjustment	Low-speed		1-1/4 turn ± 1/4			
	High speed screw		0			
	Idle speed (in water)		1500 RPM			
	Idle		300 RPM			
Fuel	Type		Regular unleaded gasoline			
	Octane no.		87 (Ron + Mon) / 2			
Fuel return line		(MAG) 0.8 mm (.031 in) - (PTO) 0.8 mm (.031 in)				
ADDITIONAL INFORMATION :						
COOLING		SPORTSTER (5895)		SPEEDSTER (5894)		
Type		Open circuit - Direct water flow				
Thermostat		None				
Overheating beeper setting		96-99°C (205-210°F)				
ADDITIONAL INFORMATION :						

Section 12 TECHNICAL DATA

Sub-Section 01 (ALL MODELS)

PROPULSION		SPORTSTER (5895)		SPEEDSTER (5894)	
Propulsion system		Bombardier Formula pump			
Number of pump		1		2	
Jet pump type		Axial flow single stage			
Impeller rotation (seen from rear)		Counterclockwise			
Transmission		Direct drive			
Coupling type		Crown splines			
Oil type		SEA-DOO JET PUMP SYNTHETIC OIL Polyolester 75W90 GL5 ①			
Steering nozzle pivoting angle		26°			
Minimum required water level		90 cm (35 in)			
Drive shaft deflection (maximum)		0.5 mm (.020 in)			
Impeller outside diameter		139.5 mm (5.490 in)			
Impeller / wear ring clearance	New	0.18 - 0.44 mm (.007 - .017 in)			
	Wear limit	1.02 mm (.040 in)			
Impeller shaft end play (new)		0.12 - 0.54 mm (.005 - .021 in)			
Impeller shaft side play		0.05 mm (.002 in)			
Impeller pitch / material		Progressive pitch 11° - 24° stainless steel		Progressive pitch stainless steel	
ADDITIONAL INFORMATION : ① Do not mix different brands or oil types.					
DIMENSIONS		SPORTSTER (5895)		SPEEDSTER (5894)	
Number of passenger (driver incl.)		3 + 1			
Draft angle		20°			
Dead rise		30 cm (12 in)			
Overall length		442 cm (14 ft 6 in)			
Overall width (beam)		216 cm (85 in)			
Overall length		107 cm (42 in)			
Dry weight		430 kg (946 lb)		567 kg (1247 lb)	
Load limit (passengers and 10 kg (22 lb) luggage)		295 kg (649 lb)			
Maximum water skiers on tow		1		2	
ADDITIONAL INFORMATION :					
CAPACITIES		SPORTSTER (5895)		SPEEDSTER (5894)	
Fuel tank (including reserve)		102 L (27 U.S. gal)			
Fuel tank reserve		12 L (3.2 U.S. gal)			
Impeller shaft reservoir	Capacity	90 mL (3 U.S. oz)			
	Oil level height	To bottom of cover hole			
Oil injection reservoir		9 L (2.4 U.S. gal)			
ADDITIONAL INFORMATION :					

Section 12 TECHNICAL DATA

Sub-Section 01 (ALL MODELS)

MATERIAL		SPORTSTER (5895)	SPEEDSTER (5894)
Hull		Composite (fiberglass)	
Air intake silencer		Thermoplastic	
Flame arrester		Multi-layer wire screen	
Exhaust muffler		Aluminum	
Fuel tank		Polyethylene	
Oil injection reservoir		Polyethylene	
Seat		Base : Polyethylene Foam : Polyurethane	
Ride shoe		Aluminum	
Jet pump		Plastic with bronze stator vanes	
Front storage cover		Polypropylene	Polystyrene
ADDITIONAL INFORMATION :			
STANDARD EQUIPMENT		SPORTSTER (5895)	SPEEDSTER (5894)
DESS (Digitally Encoded Security System)		Standard	
Tool kit		Standard	
Fuel tank reserve		Standard	
Electric fuel level gauge		Standard	
Oil injection low level / warning device		Standard	
Overheating warning device and CSI (Cooling System Indicator)		Standard	
Speedometer		Optional	Standard
Tachometer		Optional	Standard
Stern light and navigation lights		Standard	
Shifter control (Forward / Neutral / Reverse)		Standard	
Electric bilge pump (manual switch + auto)		Standard	
Blower		Standard	
Storage compartment (front / middle / rear)		Standard	
Grab handles		Standard	
Cup holders		Standard	
Mirrors		Optional	Standard
Extinguisher holder		Standard	
ADDITIONAL INFORMATION :			
PERFORMANCE		SPORTSTER (5895)	SPEEDSTER (5894)
Estimated pump power		23.5 kW (32 hp)	
Maximum fuel consumption at wide open throttle		31.5 L / h (8.5 U.S. gal / h)	63 L / h (17 U.S. gal / h)
Cruising time at full throttle	Fuel tank without reserve	2 h 40 min	1 h 20 min
	Fuel tank reserve	20 min	10 min
ADDITIONAL INFORMATION :			

Section 12 TECHNICAL DATA

Sub-Section 01 (ALL MODELS)

TIGHTENING TORQUE			SPORTSTER (5895)		SPEEDSTER (5894)	
ENGINE	Exhaust manifold screw		24 N•m	(17 lbf•ft)	(1)	
	Magneto flywheel nut		105 N•m	(77 lbf•ft)	(1)	
	Flywheel (PTO side)		110 N•m	(81 lbf•ft)		
	Crankcase screws	M6	9 N•m	(80 lbf•in)	(1)	
		M8	24 N•m	(17 lbf•ft)	(3) (4)	
	Crankcase / engine support nuts		35 N•m	(26 lbf•ft)	(1)	
	Engine support / hull		25 N•m	(18 lbf•ft)	(1)	
	Cylinder head screws		24 N•m	(17 lbf•ft)	(1) (4)	
	Cylinder head cover screws		9 N•m	(80 lbf•in)	(1)	
	Crankcase / cylinder screws		24 N•m	(17 lbf•ft)	(1) (4)	
	Tuned pipe nut / manifold stud, screws and nuts		25 N•m	(18 lbf•ft)	(1)	
	Tuned pipe fixation screws		25 N•m	(18 lbf•ft)	(1)	
	Flame arrester screws		10 N•m	(80 lbf•in)	(1)	
	Carburetor on intake manifold nuts		25 N•m	(18 lbf•ft)	(1)	
	PUMP	Impeller shaft		70 N•m	(52 lbf•ft)	(2)
Pump / hull nuts		35 N•m	(26 lbf•ft)	(1)		
Venturi / pump housing screws		25 N•m	(18 lbf•ft)	(1)		
Nozzle / venturi screws		20 N•m	(15 lbf•ft)	(1)		
Pump housing cover screws		7 N•m	(62 lbf•in)	(1)		
Reverse gate / venturi screws		25 N•m	(18 lbf•ft)	(1)		
Intake grill screws		8 N•m	(71 lbf•in)	(1)		
Ride shoe screws		10 N•m	(88 lbf•in)	(1)		
STEERING	Steering wheel nut		40 N•m	(30 lbf•ft)		
	Steering support screws		10 N•m	(88 lbf•in)	(1)	
	Steering cable retaining block bolts		6 N•m	(53 lbf•in)		
	Steering cable / helm arm screw and nut		20 N•m	(15 lbf•ft)		
	Steering cable / nozzle screw and nut		20 N•m	(15 lbf•ft)		
	Steering collar screw		5 N•m	(44 lbf•in)	(1)	
	Steering cable / hull nut		40 N•m	(30 lbf•ft)		
ELECTRICAL	Ignition housing cover screws		8 N•m	(71 lbf•in)		
	Starter mounting screws		22 N•m	(16 lbf•ft)	(2)	
	Starter lock nuts		7 N•m	(62 lbf•in)		
	Spark plugs		24 N•m	(17 lbf•ft)		
ADDITIONAL INFORMATION : Apply where indicated ; (1) Loctite 242 (blue) (2) Loctite 271 (red) (3) Loctite 515 (4) Synthetic grease (5) Anti-seize lubricant						
<div><div></div><div>WARNING : Correct torques and use of Loctite must be strictly followed.</div></div>						

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Section 12 TECHNICAL DATA

Sub-Section 01 (ALL MODELS)

ENGINE		CHALLENGER (5896)
Number of engine		1
Engine type		Bombardier-Rotax 787, water cooled
Induction type		Rotary valve
Exhaust type	Type	Water cooled, water injected
	Water injection fittings	3.5 mm (.139 in)
Starting system		Electric start
Lubrication	Fuel / oil mixture	VROI (Variable Rate Oil Injection)
	Oil injection pump	Gear driven
	Oil type	Bombardier-Rotax Formula XP-S synthetic injection oil
Number of cylinders		2
Bore	Standard	82.00 mm (3.228 in)
	First oversize	82.25 mm (3.238 in)
	Second oversize	N.A.
Stroke		74 mm (2.91 in)
Displacement		781.6 cm ³ (47.68 in ³)
Compression ratio	Uncorrected	12.00 : 1
	Corrected	5.9 : 1 ①
Engine maximum torque		110 N•m (81 lbf•ft) @ 6500 RPM
Cylinder head warpage (maximum)		0.05 mm(.002 in)
Piston ring type and quantity		1 Semi-Trapez — 1 Rectangular
Ring end gap	New	0.25 - 0.40 mm (.010 - .016 in)
	Wear limit	1.00 mm (.039 in)
Ring / piston groove clearance	New	0.025 - 0.070 mm (.001 - .003 in)
	Wear limit	0.2 mm (.008 in)
Piston / cylinder wall clearance	New	0.10 - 0.12 mm (.004 - .005 in)
	Wear limit	0.15 mm (.006 in)
Cylinder taper (maximun)		0.10 mm (.004 in)
Cylinder out of round (maximun)		0.08 mm (.003 in)
Connecting rod big end axial play	New	0.39 - 0.74 mm (.015 - .029 in)
	Wear limit	1.2 mm (.047 in)
Crankshaft deflection (center)		0.08 mm (.003 in) ②
Rotary valve timing	Opening	146.5° ± 5 BTDC
	Closing	64° ± 5 ATDC
Rotary valve duration		159°
Crankcase / rotary valve gap		0.25 - 0.35 mm (.010 - .014 in)
Connecting rod / crankshaft pin radial clearance	New	0.01 - 0.02 mm (.0004 - .0008 in)
	Wear limit	0.050 mm (.002 in)
Connecting rod / pistont pin radial clearance	New	0.003 - 0.012 mm (.00012 - .00047 in)
	Wear limit	0.015 mm (.00059 in)
ADDITIONAL INFORMATION :		
① Squish gap : 1.2 - 1.6 mm (.047 - .063 in)		
② MAG side : 0.05 mm (.002 in) PTO side : 0.03 mm (.001 in)		
N.A. : Not Applicable		

Section 12 TECHNICAL DATA

Sub-Section 01 (ALL MODELS)

ELECTRICAL		CHALLENGER (5896)
Magneto generator output		180 W @ 6000 RPM or 5 A @ 2000 RPM
Ignition system type		DC-CDI (Direct-Current Capacitor Discharge Ignition)
Spark plug	Make and type	NGK BR8ES
	Gap	0.55 mm (.021 in)
Ignition timing (BTDC)	mm (in)	3.38 (.133)
	Degrees	22° ± 1 ①
Generating coil		N.A.
Trigger coil		242 Ω
Battery charging coil		.01 - .1 Ω
Ignition coil	Primary	.34 - .62 Ω (not measurable)
	Secondary	9 - 15 kΩ
Engine RPM limiter setting		7200 (± 50) RPM
Battery		Not supplied ②
Fuse	MPEM (Multi-purpose electronic module) supply	5 A
	Fuse block supply	20 A
	Charging system	15 A
	Blower	7.5 A
	Bilge pump	3 A
	Lighting system	3 A
	Gauges and DC-CDI module	5 A
	Additional accessories	10 A
ADDITIONAL INFORMATION : ① Engine @ 3500 RPM with shifter in forward or reverse position. ② Recommended : Exide RV24-130, 12 V, 25 A•h (130 minutes reserve) or RV24-160 (160 minutes) or equivalent. Battery post : On top. Round taper type. Battery maximum allowed size : 285 mm (11-1/4") long x 190 mm (7-1/2") wide x 238 mm (9-3/8") high.		
 WARNING : Never use automotive type battery. Its mechanical construction does not allow to meet the shock condition where boats operate. Only use the type of battery recommended.		
CARBURETION		CHALLENGER (5896)
Carburetor	Type	Mikuni Diagram BN 401-38
	Quantity	2
Main jet		142.5
Pilot jet		70
Adjustment	Low-speed screw	1 turn ± 1/4
	High speed screw	0
	Idle speed (in Water)	1500 RPM
	Idle speed (out of water)	3000 RPM
Fuel	Type	Regular unleaded gasoline
	Octane no.	87 (Ron + Mon) / 2
Fuel return line orifice		(MAG) 0.8 mm (.031 in) - (PTO) 0.8 mm (.031 in)
ADDITIONAL INFORMATION :		
COOLING		CHALLENGER (5896)
Type		Open circuit - Direct water flow from jet propulsion unit
Thermostat		None
Overheating beeper setting		96-99°C (205-210°F)
ADDITIONAL INFORMATION:		

Section 12 TECHNICAL DATA

Sub-Section 01 (ALL MODELS)

PROPULSION		CHALLENGER (5896)
Propulsion system		Bombardier Formula Pump
Number of pump		1
Jet pump type		Axial flow single stage
Impeller rotation (seen from rear)		Counterclockwise
Transmission		Direct drive
Coupling type		Crown splines
Oil type		SEA-DOO JET PUMP SYNTHETIC OIL Polyolester 75W90 GL5 ①
Steering nozzle pivoting angle		26°
Minimum required water level		90 cm (35 in)
Drive shaft deflection (maximum)		0.5 mm (.020 in)
Impeller outside diameter		139.5 mm (5.490 in)
Impeller / wear ring clearance	New	0.18 - 0.44 mm (.007 - .017 in)
	Wear limit	1.02 mm (.040 in)
Impeller shaft end play (new)		0.12 - 0.54 mm (.005 - .021 in)
Impeller shaft side play		0.05 mm (.002 in)
Impeller pitch / material		Progressive pitch stainless steel
ADDITIONAL INFORMATION : ① Do not mix different brands types.		
DIMENSIONS		CHALLENGER (5896)
Number of passenger (driver incl.)		4 + 1
Draft		20°
Dead rise		30 cm (12 in)
Overall length		442 cm (14 ft 6 in)
Overall width (beam)		216 cm (85 in)
Overall height		107 cm (42 in)
Dry weight		480 kg (1056 lb)
Load limit (passenger and 10 kg (22 lb) luggage)		340 kg (750 lb)
Maximum water skiers on tow		1
ADDITIONAL INFORMATION :		
CAPACITIES		CHALLENGER (5896)
Fuel tank (including reserve)		102 L (27 U.S. gal)
Fuel tank reserve		12 L (3.2 U.S. gal)
Impeller shaft reservoir	Capacity	90 mL (3 U.S. oz)
	Oil level height	To bottom of cover hole
Oil injection reservoir		9 L (2.4 U.S. gal)
ADDITIONAL INFORMATION :		

Section 12 TECHNICAL DATA
Sub-Section 01 (ALL MODELS)

MATERIAL		CHALLENGER (5896)
Hull		Composite (fiberglass)
Air intake silencer		Thermoplastic
Flame arrester		Multi-layer wire screen
Exhaust muffler		Aluminum
Fuel tank		Polyethylene
Oil injection reservoir		Polyethylene
Seat		Base : polyethylene, Foam : Polyurethane
Ride shoe		Aluminum
Jet pump		Plastic with bronze stator vanes
Front storage cover		Polypropylene
ADDITIONAL INFORMATION :		
STANDARD EQUIPMENT		CHALLENGER (5896)
DESS (Digitally Encoded Security System)		Standard
Tool kit		Standard
Fuel tank reserve		Standard
Electric fuel level gauge		Standard
Oil injection low level / warning device		Standard
Overheating warning device and CSI (Cooling System Indicator)		Standard
Speedometer		Standard
Tachometer		Standard
VTS (Variable Trim System)		Standard
Retractable ski post		Standard
Stern light and navigation lights		Standard
Shifter control (forward / neutral / reverse)		Standard
Electric bilge pump (manuel switch + auto)		Standard
Blower		Standard
Storage compartment (front / middle / rear / ski rope / cooler)		Standard
Grab handles		Standard
Cup holders		Standard
Mirrors		Standard
Extinguisher holder		Standard
ADDITIONAL INFORMATION :		
PERFORMANCE		CHALLENGER (5896)
Estimated pump power		28.2 kW (38 hp)
Maximum fuel consumption at wide open throttle		46 L / h (12.2 U.S. gal / h)
Cruising time at full throttle	Fuel tank without reserve	2 h
	Fuel tank reserve	15 min
ADDITIONAL INFORMATION :		

Section 12 TECHNICAL DATA

Sub-Section 01 (ALL MODELS)

TIGHTENING TORQUES			CHALLENGER (5896)		
ENGINE	Exhaust manifold screw		24 N•m	(17 lbf•ft)	(1)
	Magnet flywheel nut		105 N•m	(77 lbf•ft)	(1)
	Flywheel (PTO side)		110 N•m	(81 lbf•ft)	
	Crankcase screws	M6	9 N•m	(80 lbf•in)	(1)
		M8	24 N•m	(17 lbf•ft)	(3) (4)
	Crankcase / engine support nuts		35 N•m	(26 lbf•ft)	(1)
	Engine support / hull		25 N•m	(18 lbf•ft)	(1)
	Cylinder head screws		24 N•m	(17 lbf•ft)	(1) (4)
	Cylinder head cover screws		9 N•m	(80 lbf•in)	(1)
	Crankcase / cylinder screws		24 N•m	(17 lbf•ft)	(1) (4)
	Tuned pipe nut / manifold stud, screws and nuts		25 N•m	(18 lbf•ft)	(1)
	Tuned pipe fixation screws		25 N•m	(18 lbf•ft)	(1)
	Flame arrester screws		10 N•m	(88 lbf•in)	(1)
	Carburetor on intake manifold nuts		25 N•m	(18 lbf•ft)	(1)
	PUMP	Impeller shaft		70 N•m	(52 lbf•ft)
Pump / hull nuts		35 N•m	(26 lbf•ft)	(1)	
Venturi / pump housing screws		25 N•m	(18 lbf•ft)	(1)	
Nozzle / venturi screws		20 N•m	(15 lbf•ft)	(1)	
Pump housing cover screws		7 N•m	(62 lbf•in)	(1)	
Reverse gate / venturi screws		25 N•m	(18 lbf•ft)	(1)	
VTS ring / nozzle screws		13.5 N•m	(120 lbf•in)	(1)	
VTS ring / VTS arm screws		To be distributed			
Intake grill screws		8 N•m	(71 lbf•in)	(1)	
Ride shoe screws		10 N•m	(88 lbf•in)	(1)	
STEERING		Steering wheel nut		40 N•m	(30 lbf•ft)
	Steering support screws		10 N•m	(88 lbf•in)	(1)
	Steering cable retaining block bolts		6 N•m	(53 lbf•in)	
	Steering cable / helm arm screw and nut		20 N•m	(15 lbf•ft)	
	Steering cable / nozzle screw and nut		20 N•m	(15 lbf•ft)	
	Steering collar screw		5 N•m	(44 lbf•in)	(1)
	Steering cable / hull nut		40 N•m	(30 lbf•ft)	
ELECTRICAL	Ignition housing cover screws		8 N•m	(71 lbf•in)	
	Starter mounting screws		22 N•m	(16 lbf•ft)	(2)
	Starter lock nuts		7 N•m	(62 lbf•in)	
	Spark plugs		24 N•m	(17 lbf•ft)	
ADDITIONAL INFORMATION : Apply where indicated ; (1) Loctite 242 (blue) (2) Loctite 271 (red) (3) Loctite 515 (4) Synthetic grease (5) Anti-seize lubricant					
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